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## PROMOTION OF THE MECHANIC ARTS.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE, CIVIL ENGINEERING, THE ARTS AND MANUFACTURES, AND THE RECORDING OF AMERICAN AND OTHER PATENTED INVENTIONS.

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JULY, 1852.

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## CIVIL ENGINEERING.

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### *On Metallic Constructions.* By W. FAIRBAIRN, C. E., F. R. S.*

[Paper read at the Mechanics' Institution, Manchester.]

It is nearly half a century since I first became acquainted with the engineering profession, and at that time the greater part of our mechanical operations were done by hand. On my first entrance into Manchester, there were no self-acting tools; and the whole stock of an engineering or machine establishment might be summed up in a few ill-constructed lathes, a few drills and boring machines of rude construction. Now compare any of the present works with what they were in those days, and you will find a revolution of so extraordinary a character as to appear to those unacquainted with the subject, scarcely entitled to credit. The change thus effected, and the improvements introduced into our constructive machinery, are of the highest importance; and it gives me pleasure to add, that they chiefly belong to Manchester, are of Manchester growth, and from Manchester they have had their origin. It may be interesting to know something of the art of tool-making, and of the discoveries and progress of machines, which have contributed so largely to multiply the manufactures, as well as the construction of other machines employed in practical mechanics. In Manchester, the art of calico printing was in its infancy forty years ago; the flat press, and one, or at most, two colored machines were all that were in use; the number of those machines is now greatly multiplied, and I believe some of them are capable of printing eight colors at once; and the arts of bleaching, dyeing, and finishing, have undergone equal extension and improvement. In the manufacture of steam engines there were only three or four establishments that could make them, and those were Boulton and Watt, of Soho; Fenton, Murray, and Wood, of Leeds; and Messrs. Sherratts, of this

* From the London Civil Engineer and Architect's Journal, May, 1852.

town. The engines of that day ranged from 3 up to 50, or at most, 70 horses' power; now they are made as high as 500, or in pairs from 1000 to 1200 horse. An order for a single engine at that time was considered a great work, and frequently took ten or twelve months to execute; now they are made by dozens, and that with a degree of dispatch as to render it no uncommon occurrence to see five or six engines of considerable power leave a single establishment in a month. In machine making, the same powers of production are apparent. In this department we find the same activity, the same certainty of action, and greatly increased production in the manufacture of the smaller machines, than can possibly be attained in the larger and heavier description of work. The self-acting turning, planing, grooving and slotting machines have afforded so much accuracy and facility for construction as enable the mechanical practitioner to turn, bore, and shape, with a degree of certainty almost amounting to mathematical precision. The mechanical operations of the present day could not have been accomplished at any cost thirty years ago, and what was considered impossible at that time, is now performed with a degree of intelligence and exactitude that never fail to accomplish the end in view, and reduce the most obdurate mass to the required consistency, in all those forms so strikingly exemplified in the workshops of engineers and machinists. To the intelligent and observant stranger who visits these establishments, the first thing that strikes his attention is the mechanism of the self-acting tools; the ease with which they cut the hardest iron and steel, and the mathematical accuracy with which all the parts of a machine are brought into shape. When these implements are carefully examined, it ceases to be a wonder that our steam engines and machines are so beautifully and correctly executed. We perceive the most curious and ingenious contrivances adapted to every purpose, and machinery which only required the attendance of a boy to supply the material and to apply the power, which is always at hand. This subject is an art—I would call it a science—which has occupied the attention of the greatest men from the days of Newton and Galileo, down to those of Watt and Smeaton, and it now receives attentive consideration from some of the ablest and most distinguished men of the present time. And of these I may instance Poncelet, Morni, Humboldt, Brewster, Babbage, Dr. Robison (of Armagh), Willis, and many others, to show the interest that is taken by these great men with the advancement of mechanical science. It must appear obvious to those who have studied and watched the unwearied invention and continued advancement which have signalized the exertions of our engineering and mechanical industry, that neither difficulties nor danger, however formidable, can stand against the indomitable spirit, skill, and perseverance of the English engineer; nor will it be denied, that the ingenuity and never-failing resources of our mechanical population are not only the sinews of our manufactures, railways, and steamboats, but the pride and glory of our country. A great deal has been done, but a great deal more may yet be accomplished, if by suitable instruction we carefully store the minds of our foremen and operatives with useful knowledge, and afford them those opportunities essential to its acquisition. We must try to unite theory with practice, and bring the philosopher into close contact with the practical mechanic. We must try to remove prejudices, and to encourage a sounder system of management

in the manufactures, design, and projects of the useful arts. When this is accomplished, we shall no longer witness abortions in construction, but a carefully, well digested system of operations founded on the unerring laws of physical truth.

To the student in architecture, engineering, and building, there is scarcely any acquirement more essential to professional success than a knowledge of the properties of materials which are used in construction. It is more important than either skill in design or correctness of proportion, whatever the character of the structure—be it a house, a ship, a bridge, or a machine. Before we enter upon its construction, and before we can attain a due and correct proportion of the parts, we must, as a preliminary inquiry, make ourselves acquainted with the material of which it is composed. We must study this material's powers of resistance when exposed to the varied strains of tension, torsion, and compression. We must know something of its elasticity and its powers of restoration under the strains and changes to which it may be subjected; and we must then apply that knowledge by distributing it in such form and quality as will best meet the requirements of the case, and without incurring the charge of an unnecessary or wasteful expenditure. All this knowledge appears to me to be indispensable, before we can attain anything like perfection in the art of construction; and no professor of the useful arts, whether he be an architect, engineer, or builder, can ever lay claim to sound principles of construction, unless he is acquainted with the natural properties of the material with which he deals. I shall, therefore, lay before you, in a tabulated form, a short summary of experimental facts, which you will, I think, find of some importance in their bearing upon the particular construction to which I allude.

*Resisting Powers of Cast Iron.*—From a number of carefully conducted experiments on cast iron, I have selected the following results. They are the highest in the order of their powers of resistance to a transverse strain, and as in each instance the bar is reduced to exactly one inch square, the results may fairly be estimated as a criterion of the resisting powers of the different irons of Great Britain:—

*Transverse Strength of Cast Iron Bars, 1 inch square, 4 ft. 6 in. between the Supports*

| | Name and No. of Iron. | | Breaking weight in lbs. | Deflexion in inches. | Power to resist Impact. |
|---|---|---|---|---|---|
| Welsh. | Ponkey, | 3 C | 581 | 1·747 | 992 |
| | Beaufort, | 3 H | 517 | 1·599 | 807 |
| | Beaufort, | 3 C | 448 | 1 726 | 747 |
| | Mean, | | 515 | 1·6?1 | 848·6 |
| English. | Low Moor, | 2 C | 472 | 1·852 | 855 |
| | Butterley, | H | 502 | 1·815 | 899 |
| | Elscar, | 2 C | 427 | 2·224 | 992 |
| | Old Park, | 2 C | 485 | 1·621 | 718 |
| | Mean, | | 471 | 1·778 | 863·5 |
| Scotch. | Muirkirk, | 1 C | 418 | 1.570 | 656 |
| | Carron, | 3 C | 443 | 1·336 | 593 |
| | Monkland, | 2 H | 403 | 1·762 | 709 |
| | Gartsherrie, | 3 H | 447 | 1·557 | 998 |
| | Mean, | | 428 | 1·556 | 739 |

The letters C signify cold blast; H, hot blast.

From the above, it will be perceived that the average transverse strength

of eleven specimens of English, Welsh, and Scotch iron is 471 lbs. on 1 inch square bars, 4 ft. 6 in. between the supports. These again, give a mean deflexion of 1·675 inches, and a power to resist impact of 817. Similar irons will resist a tensile strain and a crushing force per square inch as follows:—

*Experimental results to determine the ultimate Powers of Resistance to a Tensile and Crushing Strain; Specimens each 1½ inch high.*

| Description of Iron. | | Tensile strength per sq. in. of section. | Crushing strength per sq. in. of section. | Ratio of Tension to Compression. |
|---|---|---|---|---|
| Low Moor, | No. 2 | 6·901 tons. | 41·219 tons. | 1 : 5·973 |
| Clyde, | No. 2 | 7·949 | 45·549 | 1 : 2·729 |
| Blenarvon, | No. 2 | 7·466 | 45·717 | 1 : 6·123 |
| Brymbo, | No. 3 | 6·923 | 34·356 | 1 : 4·963 |
| Mean, | | 7·309 | 41·710 | 1 : 5·707 |

In the foregoing experiments, the Clyde and Blenarvon indicate the greatest powers of resistance, either as regards a tensile or a crushing strain.

In addition to the irons given above, which are those in common use, Mr. Stirling's mixed or toughened iron exhibits considerably increased powers of resistance to every description of strain when compared with the unmixed irons. Mr. Stirling has patented a process for mixing a certain portion of malleable with cast iron, and when carefully fused in the crucible, the product is equal to resist a tensile strain of nearly 11 tons per square inch, and a compressive one of upwards of 60 tons, the specimens being 1½ inch long and 1 inch square. This mixture, when judiciously managed and duly proportioned, increases the strength about one-third above that of ordinary cast iron. As the strength of wrought iron is not only a subject of great interest at the present moment, but is likely to become more so every year, I shall have to trespass longer upon your attention than may be agreeable. It is, however, imperative that I should do so, as I shall have occasion before the close of my remarks, to refer to facts, and to deduce therefrom conclusions for the elucidation and illustration of my subject. The importance of an inquiry into the art of ship building will be appreciated by you all, and when you bring to mind the dreadful casualties of navigation—the hardships of shipwreck, and the horrors of fire—you will admit the vast importance of selecting the strongest and safest materials for the construction of our ships. It is chiefly for this reason that I have selected this subject, and ventured to impose upon your attention a few dry figures, in order that you might become acquainted, first of all, with the strength and natural properties of the materials of which ships are ordinarily composed, and attach due weight to their judicious application and distribution in the attainment of a powerful, buoyant, and durable structure. I would not have ventured upon this critical and difficult subject without some practical experience, but having taken an active part, as well as a deep interest, in the earliest stages of the application of iron as a material for ship building, and having until the last two years been extensively engaged as a practical builder, I am perhaps the better able to offer a few suggestions on the advantages and superiority of iron in our war, as well as in our mercantile marine. It is well known to the public that the naval department of the

government abandoned, a few years back, (I think improperly so,) the construction of iron vessels as ships of war. The Admiralty, in my opinion, arrived at a very hasty conclusion in condemning the use of iron, after the very limited number of experiments which had been tried upon iron targets and old iron vessels as to the effects of shot. At several of these experiments I was requested to be present, and although the results were certainly unexpected, and perhaps discouraging, yet they did not, in my opinion, justify the abandonment of a material not only the strongest and lightest for such a purpose, but offering infinite security under all ordinary and many extraordinary circumstances. Even in war steamers when in action the chances are in favor of the iron ship, as it is not only secure from fire, but is much stronger, and will sustain more strain when assailed by storms and hurricanes. Steamers can back out of difficulties and dangers, when sailing vessels must remain exposed; they can assail the enemy at a great distance, and take up any position they choose; and with their great guns and long range inflict severe punishment, and do great execution without receiving a single shot. Speed being thus admitted to be an important element in our war marine, the iron ship, from its lightness and buoyancy, has another evident advantage over the wooden one, as an equal amount of power will propel it faster through the water. In the event of a war, the steam marine of this country should have great command of power, to enable the ship to manœuvre at sea with almost the same geometrical precision as a squadron of horse on parade. They should have the power to advance and retreat as circumstances may require, and the new system of tactics which eventually must come into operation, should inspire confidence in the crew as well as the commander, that the iron steamer is not only formidable but safe, as embodying all the elements of offensive and defensive warfare. In our mercantile marine we are progressing with better prospects and greater certainty; but the decision of the Admiralty to limit the construction of iron vessels in the mail and packet service is, according to my views, uncalled for, and, to say the least of it, inconsiderate. I trust the lords commissioners of the Admiralty will see the necessity, the absolute importance, of rescinding that order, and that we shall not only witness the introduction of iron for that service, but more particularly when steam power is employed in all and in every condition of an effective and a safe marine.

(To be continued.)

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*The Economy of Railways, as a Means of Transit, comprising the Classification of the Traffic, in Relation to the most appropriate Speeds for the Conveyance of Passengers and Merchandise.* By Mr. Braithwaite Poole.*

After referring to the influence which cheap and rapid communications had on the prosperity of a nation, the author alluded to the rise of the railway system in this country, expressing the belief that it would have been economical and wise, if the legislature had in the first instance determined the lines on which the system of railways should have been constructed

* From the London Atheneum, April, 1852.

throughout the kingdom, so as to have avoided the present ruinous competition. The passenger traffic now exceeded, annually, four times the entire population of Great Britain, and was conveyed at three times the speed and one-third the fares formerly charged by the old stage or mail coaches, whilst the cost of conveyance of merchandise, minerals, and agricultural produce, had been reduced 50 per cent., as compared with the rates charged on canals and turnpike roads fifteen years ago. The ordinary fares for passengers ranged from twopence three farthings to a half penny per mile, and for merchandise from one penny to sixpence per ton per mile. The author then proceeded to consider the economy which might be introduced into the working of railways, and divided the subject into sixteen different heads, each of which referred to some particular point where it was thought a reduction of expenses might be made. The principal point advanced was, the amalgamating, or working, of all the railways in four great divisions, and insuring unity of management in every department, in the maintenance of the permanent way, and of the rolling stock, as well as in their manufacture—several improvements in the construction of the wagons being suggested. If a general classification of trains were arranged throughout the kingdom, separating each class, and running them at different speeds whenever practicable, it was thought that it would be conducive to the interest of all parties, as it was urged to be a manifest injustice towards those who paid the highest fares to find third-class passengers arriving at the same time with them. Punctuality and regularity required to be strictly attended to for the maintenance of a certain definite speed. Numerous instances were adduced to show the vast advantages and economy of the railway system, without which the penny postage could not have been achieved, or the Great Exhibition rendered available to the multitude; the produce of the land and sea, in vegetables, fruit, meat, fish, all provisions and fuel, would have remained as limited in consumption as heretofore; and the poor man's fireside in the rural districts would never have been warmed by coal.—*Proc. Inst. Civ. Eng., April* 20, 1852.

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## *Cost of Locomotive Power on the Caledonian Railway.**

During the last half year, the locomotive power on the Caledonian Railway has cost, for passenger trains, 6·66d. per mile; for goods trains, 9·47d.; and for mineral trains, 7·20d.; the average being 7·61d. per mile run, against 8·47d. during the preceding half year. The expense of locomotive power and carriage stock averages 9·78 per mile, against 10·90d. at the corresponding period of the preceding year. The number of miles run with passenger trains amounts to 473,691; with goods, 296,232; and with minerals, 251,499; total, 1,021,422 miles. The number of miles run by pilot engines was 95,352. The average number of engines in working order during the half year is 107, and under repair 17. The average number of carriages in passenger trains 7, and of wagons in goods trains 24·47. The working stock consists of 73 passenger engines, 51 goods engines, 58 first class carriages, 76 second class, 108 third class, 19 com-

* From the London Practical Mechanic's Journal, May, 1852.

posite, 2 saloons, 6 post offices, 18 luggage vans, 15 carriage trucks, 15 horse boxes, 17 break wagons, 900 ordinary wagons, 52 coke, 20 covered, and 152 cattle wagons, 10 fish vans, 10 sheep wagons, 3200 mineral wagons, and 2 ale wagons.

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## AMERICAN PATENTS.

*List of American Patents which issued from May 4th to June 1st*, 1852, (*inclusive*,) *with Exemplifications by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in Rock Drills;* William F. Ash, Springfield, Ohio, May 4.

*Claim.*—"Having thus fully described the construction of my machine, what I claim therein as my invention is, in combination with the cam wheel and guide, the hanging of the lever, by which the drill is raised, on a jointed arm, so as to give it two sets of motions, viz: up and down, to lower and raise the drill, and a backward and forward motion, from and towards the cam wheel, to operate the machine without noise or jar; the whole being arranged substantially in the manner and for the purpose specially set forth and described."

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2. For an *Improvement in Leather Gauges;* Lewis W. Beecher, Avon, New York, May 4.

*Claim.*—"What I claim as my invention is, the wheel with its inclined planes or wedges, arranged so as to act upon the roller frame, substantially in the manner herein set forth."

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3. For an *Improvement in Potato Washers;* Alonzo Bentley, Honesdale, Pennsylvania, May 4.

"The nature of my invention consists in the employment of a revolving screen concentrically within a closed cylinder; the shaft of the former running through tubular projections forming the bearings of the latter; the potatoes being fed within the revolving screen, and water or steam supplied as requisite."

*Claim.*—"What I claim as my invention is, the screen and cylinder combined, the screen working within the cylinder, and its axis or shaft working within or through the tubular projections or bearings of the same, substantially in the manner and for the purposes set forth."

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4. For an *Improvement in Lever Jacks;* Levis H. Davis, Assignor to J. A. Dugdale, Kennett's Square, Pennsylvania, May 4.

*Claim.*—"What I claim as my invention is, the combination of lever, the lip, and the cleat constructed as herein set forth, with the dog and the spring, so as to act together in the manner and for the purposes herein stated."

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5. For an *Improvement in Electro-Magnetic Alarm Bells;* Moses G. Farmer, Salem, Massachusetts, May 4.

"My invention consists of mechanism of peculiar construction, which is put in operation by electro-magnetism, and so combined with a train of wheel work, cams, spring, weights, and a hammer, to cause successive blows to be struck upon a bell, any required number of times; the main feature of the invention consisting in this, that I am enabled, by its use, to bring into action any desirable amount of force, either of gravity, of a spring, of currents of air, or of steam, and control the duration of the same by the electro-magnet."

*Claim.*—"I claim as my invention, the combination, substantially as herein set forth, of the electro-magnet and armature, (or its electro-magnetic equivalent,) with the falling ball, or spring, and the detents, and the lifting cam, or its equivalents; so arranged, that

when the ball is supported by the armature, a slight force, only, of the electro-magnet, is required to trip the ball; which ball, in falling, acquires sufficient momentum to produce much greater mechanical effects than the magnet alone; the velocity of the ball, in falling, being still further accelerated by the force of a spring if desired; the power thus obtained, I use in the manner and for the purpose herein described."

6. For an *Improvement in Washing Machines;* Christian Hollingsworth, Liberty, Indiana, May 4.

"The feature of novelty of my invention consists in the employment of balls of wood or other substance of sufficient hardness and buoyancy, which, floating in the water, in contact with the linen, the latter being worked up and down, between and among the balls, is subjected to a constantly varying and yielding rubbing pressure."

*Claim.*—"Having thus described the nature of my invention, what I claim therein as new is, the application, substantially as described, to the process of washing, of balls of wood, or other buoyant material, in connexion with a reciprocating frame, or equivalent device, by means of which a rolling, yielding, or evenly pressing surface is presented to the clothes, or other articles to be washed."

7. For an *Improved Adjustable Wrench;* Andrew Hotchkiss, Sharon, Connecticut, May 4.

*Claim.*—"What I claim as my invention is, constructing the collar or eye of the inner jaw, with an aperture therein of greater section than the bar on which it slides, in combination with the spring therein, and the screw thereto attached; the whole constructed and operating substantially in the manner and for the purpose herein described."

8. For an *Improvement in Differential Safety Valves;* John M'Clintic, Philadelphia, Pennsylvania, May 4.

*Claim.*—"Having thus fully described my improved safety valve, I would state that I do not claim constructing a valve that shall act upon the differential principle, or one which will not admit of the application of external weight or pressure; but what I do claim as new is, the peculiar arrangement and combination of the hollow cylinder box, D, sliding in case A, with the conical valve, and tubular valve rod, and escape pipe, constructed and operating substantially as in the manner and for the purpose herein fully set forth."

9. For an *Improvement in Railroad Car Brakes;* Thomas G. McLaughlin, Kensington, Pennsylvania, May 4.

*Claim.*—"What I claim as my invention is, the employment of the radial bar, turning loosely on the brake lever shaft of the tender or forward car, and spring, for enabling the brakesman to operate the brake of the tender or forward car on which he is stationed, without altering the position of the radial bar after being set, as described."

10. For an *Improved Anvil;* Charles Peters, Trenton, New Jersey, and William Fetter, Bucks County, Pennsylvania.

*Claim.*—"What we claim as our invention is, a cavity in the body of anvils, for the purpose of cooling the same, by the introduction of water or other fluid into the said cavity, while the faces of the said anvils are undergoing the process of tempering."

11. For *Improved Machinery for Grinding Conical Edged Knives;* James L. Plimpton, Westfield, Massachusetts, May 4.

*Claim.*—"Having thus fully described the nature, construction, and operation of my invention, I will now state what I claim as new therein; I claim, 1st, the combination of the curved way and table thereon, provided with appropriate automatic contrivances for traversing the latter along the former, with the carriage on which they are both supported, and which is provided with axis and screws, or their equivalents, to adjust said carriage to any required angle with the horizon, for the purpose herein fully described.

"I claim, 2d, operating the feed motion, or the motion for carrying the edge of the knife across the periphery of the stone, by means of a roller bearing on the periphery of the stone, in the manner and for the purposes herein fully set forth.

"I claim, 3d, connecting the carriage and the table which carry the knife, with the roller receiving motion from the stone, by means of the combination of mechanism, substantially as herein described, by which the motion of the roller towards the axis of the stone, consequent upon the wear of the stone, will cause the knife or knives being ground, to follow the periphery of the stone, and thereby compensate for its wear, and preserve the required form of the edge or edges of the knives, viz: that of an arc of a circle, as herein fully set forth."

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12. For an *Improvement in Churning Machines;* Gelston Sanford, Ellenville, New York, Assignor to George A. Meacham, Enfield, Connecticut, May 4.

*Claim.*—"Having thus fully described my invention, what I claim therein as new is, the arrangement of dogs or pawls, J $J^1$, and pin *h*, with wedges K, L, for the purpose of tripping each other."

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13. For an *Improvement in Funnels;* Christen Schneider, Washington, District of Columbia, May 4.

*Claim.*—"What I claim as my invention is, the measuring funnel, constructed substantially as herein set forth, with an interior ventilating tube, to admit air beneath the valve."

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14. For an *Improvement in Machinery for Grinding or Polishing Saw Blades, etc.;* William Southwell, Kensington, Pennsylvania, May 4.

*Claim.*—"1st, The combination of two grindstones, or their equivalents, revolving in the direction herein made known, for the purpose of grinding or polishing two sides of a saw or other article, simultaneously, with a reciprocating frame, or its equivalent, for the purpose of holding the article being ground or polished, whereby the tendency of either stone to move the article is counteracted by the action of the other stone, and the same force is thereby required to reciprocate the article in either direction, as described.

"2d, The combination of the right and left hand screws, carriers, and nuts for said screws, movable pedestals or boxes, together with the cross shaft, worms, worm wheels, and handles, substantially set forth, for the purpose of moving two grindstones, or their equivalents, simultaneously against opposite sides of an article being ground or polished as described.

"3d, I do not claim giving an automatic traverse motion to grindstones; but what I do claim is, the arrangement of screws, mitre wheels, handles, eccentrics, eccentric boxes, and movable frame, substantially as herein described, whereby I am enabled, at any time, to move the grindstones, or their equivalents, entirely across the machine, for the purposes set forth, without interfering with the automatic traversing motion which is given to the said stones, irrespective of their precise position with reference to either saw frame or either saw, or other articles fixed in said frame.

"4th, The arrangement in the same machine, of two sets of reciprocating frames, either of which can be stopped without affecting the other, and a carriage, whereby the grindstones can be caused to move from one frame to the other; by which arrangement one saw can be ground or polished, while another is being adjusted into place."

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15. For an *Improvement in Lightning Rods;* James Spratt, Cincinnati, Ohio, May 4.

*Claim.*—"Having thus fully described the nature of my improvement, what I claim therein as new is, the formation of the point of a lightning rod, of three or more metals, encased one within another, the most fusible to the outside, in order to prevent the destruction of the entire point, by melting from an overcharge of the electric fluid."

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16. For an *Improvement in Window-Blind Machinery;* Daniel H. Thompson, Springfield, Massachusetts, May 4.

*Claim.*—"Having described the nature, construction, and operation of my invention, I will proceed to state what I claim. I claim, 1st, Hanging the auger shaft in swinging

arms or gates of different lengths, hung on centres, said centres being in line, so that by moving the said swinging arms or gates nearer to or further from a position at right angles to the line in which the centres are placed, the distance between the said auger shafts, taken in lines parallel to the line of centres, will be increased or decreased, and thereby be adjusted to different widths of slats lying upon each other, as herein substantially set forth.

"I claim, 2d, The combination of the sliding bar or carriage, carrying the stiles and rods, with the reciprocating carriage, carrying the mortising augers and wire hole pickers, in the manner substantially as described, for the purpose of boring the mortises in the slats, and pricking the wire holes in the rods, and ensuring the distances between the mortises and points of attachment of the slats being precisely the same throughout.

"I claim, 3d, The reciprocating slat table, or bed, made in three parts, X, Y, $Y^5$, the two end parts of which are adjustable to the middle part, in combination, substantially in the manner described, with the adjustable cutter heads, to wit: the end parts Y, $Y^5$, of the table or bed, and the cutter heads being adjustable, relatively to each other, for the purpose of tenoning or turning down the pivots on both ends of slats of various lengths.

"I claim, 4th, Pricking the wire holes in the slats, and feeding them at proper intervals from the box in which they are contained, to the bed or table upon which they are tenoned, by means of a vibrating feeder, deriving its motion from the bed or table carrying the slats, the said feeder being provided with suitable horns, or their equivalents, and prickers, for the purpose of entering the box, and pricking and pushing out the slats one after the other, in succession."

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17. For an *Improvement in Speaking Tubes;* Thos. J. Woolcocks and Wm. Ostrander, City of New York, May 4.

*Ceaim.*—"What we claim as of our invention is, the combination of an alarm valve with a speaking tube, or pipe, in the manner and for the purpose substantially as herein set forth."

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18. For a *Blind and Shutter Fastener;* Samuel Barker, City of New York, May 11.

"The nature of my invention consists in securing or fastening shutters, by having the upper portion of the pintle of the hinge of a square or many sided form, and the upper part of the socket (its inner surface) of a corresponding figure, a space being between the upper portions of the socket and pintle; a cap corresponding in form to the upper portions of the socket and pintle, fits over the pintle, and prevents the socket from turning around it, and consequently the shutters from swinging."

*Claim.*—"What I claim as new is, the method of securing or fastening window shutters, by having the upper portion of the pintle of the hinge of a square or other many sided form, and the upper portion of the socket of a corresponding shape, a space being between the socket and pintle, to receive the cap, which corresponds in shape to the upper portion of the pintle and socket, and fits on the pintle and in the socket, securing or fastening the shutter, as herein specified."

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19. For an *Improvement in Portable Cot Bedsteads;* William C. Betts, City of New York, May 11.

*Claim.*—"What I claim as my invention is, 1st, The elevation in the side rails, as a substitute for the pillow, as described.

"2d, I also claim the dovetails, as used, for attaching and detaching the legs to and from the side rails, that is to say, the dovetails entering their mortises from opposite ends of the cot frame, so that they cannot readily loosen by use.

"3d, I also claim the arrangement of the right and left hand screws, which unite the opposite legs at their crossings, in such a manner that the screws shall tend to tighten the joint as the legs separate from each other, or loosen the same as they approximate.

"4th, I claim the combination of the tense bars, having right and left screws, with the side rails of a cot bed, for the purpose of keeping the sacking bottom tense."

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20. For an *Improvement in Railroad Car Seats;* Abel B. Buell, Westmoreland, New York, May 11.

"The nature of my invention consists in attaching to the backs of the ordinary car seats, outer sliding backs, which may be raised or lowered, as required."

*Claim.*—"What I claim as my invention is, constructing the backs of railroad car seats with outer sliding backs, fitting in slides, and held by springs, for the purpose of elevation above the ordinary back, or depression below it, as herein shown and set forth."

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21. For an *Improvement in Meat Cutters;* William Burns, Rome, Ohio, May 11.

*Claim.*—"I am aware that most of the parts contained in this description of my improved sausage machine are not in themselves, separately considered, novel; but that they are, singly, or more or less connectively, in similar machines, been employed or patented, such as a cylinder armed with knives, and rotating within a concave, the frame having a feed opening and a discharging channel, and the gearing for imparting to the cylinders a rotary motion. I therefore do not claim as new any of these parts separately considered, or irrespective of the manner or arrangement in which I propose, in combination, to apply them for the purposes and to produce the advantages specified.

"But what I do claim as new is, arranging in separate concaves, maintaining vertical positions and uniting with each other, two cylinders, the one above the other; the upper one operating to partially mince the meat, and deliver it upon the lower cylinder, revolving at a greater speed, for reducing it to the required fineness, as described."

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22. For an *Improvement in Measuring Faucets;* Jacob R. Byler and George W. Sensenich, Beartown, Pennsylvania, May 11.

"The nature of my invention consists in so forming a measuring and drawing faucet, as that it shall always be filled with the fluid or liquid to be drawn, and so that it may be forced or drawn out of the faucet at any time and immediately, without awaiting the sluggish movement of such articles as above mentioned."

*Claim.*—"What we claim therein as new is, the so constructing of a faucet for measuring and drawing molasses, honey, oil, tar, or other liquids, as that they shall always stand charged with a measured quantity of the liquid, which may be forced out of the faucet instantaneously, however thick or sluggish it may be, when the same is accomplished by means substantially the same as herein described and represented."

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23. For an *Improvement in the Manufacture of Brushes;* Abbot R. Davis, East Cambridge, Massachusetts, May 11.

*Claim.*—"I claim as my invention the above described improvement in filling the holes of a brush-block with bristles, the same consisting in the employment of a frame to contain said bristles in mass, and hold them in the brush-blocks, and in the direction of their respective holes in the block, in combination with giving to such block and frame such movements, rappings, jarrings, or blows, as to cause the bristles, by the force of gravity or concussion, to pass into and fill the holes in the block, as hereinbefore stated."

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24. For an *Improvement in Cooking Boilers;* L. S. De Bibory, Baltimore, Maryland, May 11.

*Claim.*—"What I claim as my invention is, the application of the small cup to the cooking pot, as herein described."

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25. For an *Improvement in Apparatus for Soldering in a Vacuum;* Joseph B. and John R. Horne, Xenia, Ohio, May 11.

*Claim.*—"What we claim therein as new is, the application to the purpose of soldering in vacuum, of a hollow bent tube for the reception of a heater, the said tube being closed at the lower end, and provided with a screw-thread at its upper end, fitting tightly within a screw neck or collar upon the glass receiver of an ordinary air pump, or other suitable instrument for producing a vacuum, the bent form of the tube bringing it to bear, during its rotation, upon the perimeter of the circular disk which closes the aperture."

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26. For an *Improvement in Blocks for Printing Oil Cloths;* James Jenkins, Elizabethtown, New Jersey, May 11.

"The nature of my invention consists in attaching to two of the corners of wooden pat-

tern blocks, a gauge, admitting of adjustment to accommodate the expansion and contraction of the wood; also, by means of horizontal pitch points, (formed of a screw working in a collar on the gauge,) adjusting the parallelism of the edge of the block and face of the stock, enables the printer more accurately and expeditiously match the block, or as it is technically termed, register."

*Claim.*—"Having described the nature and operation of my invention, I do not claim the construction of the stock or gauges thereon; but what I do claim as new is, the movable gauge, in combination with the adjustable point, or its equivalent, to compensate for the contraction and expansion of the pattern block, in the manner and for the purpose substantially shown and described."

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27. For an *Improvement in Platform Scales;* Robert Newell, Lebanon, Indiana, May 11.

*Claim.*—"What I claim as new in the above described scale or balance is, the rod, *v*, and the rod and socket, *w*, and sector, *z*, or their equivalents, in combination with the revolving head and face, (or graduated plate,) and hand or index, to show at once, and in any required direction, the weight of the article weighed."

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28. For an *Improvement in Lead Pipe Machinery;* Benjamin Tatham, City of New York, May 11.

"My said invention is an improvement upon the method of making pipes from set or solid lead, described in the specification of a patent granted to Thomas Burr, of Shrewsbury, in Shropshire, England, dated the 11th day of April, A. D. 1820."

*Claim.*—"I am aware that the invention of this machinery describes the core as being forced to the centre of the die, and retained there by the pressure of the issuing pipe; and therefore I do not claim, broadly, having the core so that it shall not be affected by the vibrations of the ram.

"What I do claim as my invention is, connecting the core with the ram, by means of an universal joint, or its equivalent, substantially as specified, so that the core shall be retracted with the ram, in combination with the cylinder and die of a machine for making pipe by pressure, from lead or other soft metal, run into the cylinder and on to the said core in the molten state, substantially as specified, whereby the core is retracted with the ram, and held in position while the charge is poured in, and during the operation of forming the pipe, the vibrations of the ram do not practically affect the central position of the core in the dies, as herein specified."

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29. For an *Improvement in Tables;* Timothy H. Taylor, Fayetteville, New York, May 11.

*Claim.*—"I claim, 1st, The employment of flies, *g g*, levers, *h h*, or their equivalents, in combination with the spiral springs, *e*, or their equivalents; the whole being constructed and arranged and operating in the manner and for the purposes substantially as herein set forth.

"2d, The employment in the manner substantially as herein described, of the levers, *h h*, or their equivalents, in combination with the flies, *g g*, for the purpose of lowering the table leaves when desired."

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30. For an *Improvement in Gold Beating Machinery;* William Vine, Hartford, Connecticut, May 11.

"The nature of my invention consists in the combination of a cam, or its equivalent, so constructed as to be of a double form and action, with a rod sliding through a cylinder which is provided with a pivot, so that it is free to move horizontally; said rod giving the appropriate movement to the packet, and the object of the invention being to give to said packet motions in two directions with only one cam."

*Claim.*—"What I claim as my invention and improvement is, the double action adjustable, differential cams, or their equivalent, combined with the sliding rod and pivoted cylinder, in connexion with other parts of gold beating machinery, substantially in the manner and for the purpose as herein set forth and described."

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31. For an *Improvement in Mash Tuns;* Robert Wicks and James Faulkner, Jr., Williamsburg, New York, May 11.

"The nature of our invention for cooling the contents of the mash tun, consists in ap-

plying the top, bottom, and sides of the tun with sufficient water, until the enclosed mash is reduced to the proper temperature."

*Claim.*—"What we claim as our invention is, the completely enveloping the mash tun with water, or sufficiently so to produce the desired rapidity in cooling the mash."

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32. For an *Improved Implement for Cutting Butter from Firkins;* Nathaniel Woodbury, Salem, Massachusetts, May 11.

*Claim.*—"What I claim as new is, the knife operated by means of the levers, or their equivalents, in combination with the piston, and the box, the knife, levers, and piston being constructed, arranged, and operated, in the manner and for the purpose substantially as herein shown and described."

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33. For an *Improvement in Carding, by which Variegated Slivers are Produced;* Jonas Holmes and Ephraim French, Lee, Massachusetts, May 18.

*Claim.*—"What we claim as our invention and improvement is, traversing the doffer or doffers of a card, or setting the teeth upon them, serpentine or zig-zag, or serpentine and zigzag, or in such other curves, points, or angles, as may suit the taste or fancy of the operator; also to traverse them when so set, if desirable, so as to take the wool or other materials, from such parts of the main or other cylinder of the card, and deliver it to the condensing rollers or other apparatus, so as to make roving variegated, either in colors, or materials, or both, when said colors or materials are fed upon the card, substantially as described."

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34. For an *Improvement in Stoves;* George W. Kennison, Newburyport, Massachusetts, May 18.

"In a stove constructed on my improved plan, a most perfect control of the draft and consumption of the coal is attained, with a distribution of radiated heat, that renders the stove very pleasant and agreeable in its effects on the air (of the apartments) that impinges against the external surface of the drum."

*Claim.*—"It is therefore that my invention, and what I claim, consists in a combination of the following particulars, or elements, viz: 1st, A close drum or chamber, made with one or more air inlets, and their closing slides or doors in the lower part, and a fuel opening and door, at or near its upper part.

"2d, A fire pot or chamber of combustion, placed within the said drum, and having a grate in its lower part, and a smoke discharge pipe leading out of it, at or near its upper part.

"3d, An air space under the fire pot grate.

"4th, A space between the external sides of the fire pot and the internal sides of the drum, and made to freely communicate with the space under the grate.

"5th, A space above the fire pot, or place for the fuel, and made to freely communicate with the space around the fire pot.

"6th, A fuel supply opening and door, and an air register in the top of the fire pot; the whole being arranged and made to operate together substantially as above described."

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35. For an *Improved Ships' Block;* Charles H. Platt, City of New York, May 18.

"The nature of my invention consists in encompassing the cheeks of the block with metal hoops or bands, which fit in grooves in the peripheries of the cheeks; said hoops or bands being bent at the upper end or part of the block, so as to form eyes, through which a bolt passes which secures the cheeks the proper distance apart at the upper end."

*Claim.*—"I do not claim the metal plate for connecting the cheeks, for that has been previously employed; but what I claim as new is, the employment or use of the metal bands or hoops; said hoops or bands encompassing the cheeks, and fitting in grooves in the peripheries of the cheeks, the hoops or bands having eyes formed in them at the upper end of the block through which the bolt passes, securing the cheeks the proper distance apart at the upper end of the block, as set forth."

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36. For an *Improvement in Umbrellas;* J. V. Tibbets, City of New York, May 18.

"The nature of my invention consists in having a certain number of steel rods brought

to a spring temper, and attached at their tops, either by springs or joints, to a slide; said slide being placed upon a vertical rod; this forms the frame."

*Claim.*—"Having thus described my invention, and the manner of using the same, I wish to state that I do not lay special claim to the device consisting of a female screw slide, working over or on a screw rod, and operating together, for opening and closing the frame of the umbrella, as the devices to effect this may be varied; but what I do claim as my improvement is, distending or opening the umbrella, by the rods which have heretofore simply served as stays to the covering, and been permanently attached thereto; the covering being secured to the apex of the central rod, and the lower ends of the distending rods; and this I claim, whether the inner ends of the distending rods be made to descend, or the central rod to ascend with the apex of the covering, in distending the umbrella.

"I also claim the manner of securing the cover to the frame, viz: by means of swivels attached to the cover, and screwed into the ends of the rods, as herein described.

"I also claim the application of the springs of the rods F, to the slide E, operating in the manner and for the purpose described."

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37. For *Improvements in Iron Safes;* William Alford and John D. Spear, District of Southwark, Pennsylvania, May 18.

*Claim.*—"What we claim as our discovery, invention, and improvement is, the application of chalk, or whiting, which has been subjected to the action of acids, and has been partially deprived of the carbonic acid, the material which we use being in fact the waste or residual matter, left from the manufacture of what is called mineral water, after chalk or whiting has been subjected to the action of acids, for the purpose of expelling a portion of its carbonic acid; this residual matter consisting substantially of the substances named in the analysis before referred to, in the construction of double iron chests, or safes, in the manner above described, or in any other manner substantially the same."

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38. For an *Improvement in Saw Sets;* Asahel G. Bachelder, Lowell, Massachusetts, May 18.

*Claim.*—"What I claim as my invention is, the dog or set, J, so constructed and arranged, as to traverse or slide upon a rod or bar, in a direction parallel to the toothed edge of the saw, for the purpose of setting the same, substantially as described."

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39. For an *Improvement in Straining Saws in Saw Mills;* Edm. Booth, Philadelphia, May 18.

"The nature of my invention consists in the employment of a lever, passing through and working freely in, and up and down an oblong slot, cut in a vertical post secured to the top, and nearly in the centre of the saw mill. This lever is attached at one end, near its fulcrum, to a rod or link, which connects it to a spring secured to the top of the saw mill, and the other end is inserted into the upper guide rod of the saw, and works in a slot in the same."

*Claim.*—"What I claim as new is, the employment of the lever, or its equivalent, the spring connected to the lever by a rod or link, which is secured or attached to the lever, near its fulcrum, both operating together and in combination with a reciprocating saw, connected to the lever, and the whole being constructed and arranged and operating substantially as herein described."

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40. For an *Improvement in Cartridges for Breech Loading Guns;* Wm. W. Marston, and Frederick Goodell, City of New York, May 18.

*Claim.*—"We do not claim to have invented any of the separate parts described herein; but we do claim as new and of our own invention, the application of the leather breech piece to cartridges used with breech loading guns, such leather breech piece serving the purposes of a foundation for its own cartridge, a protection to the breech pin, a wad for the next cartridge in succession, and of a swab to clean out the soilage caused in the barrel by the antecedent explosion, producing a safe cartridge for pieces that load at the back of the breech, and in which explosion is also caused in the line of the axis of the barrel, substantially as described and shown, but without regard to the sizes of arms

used with these cartridges, and irrespective of the machinery, or mechanical means, by which the cartridge itself is made."

41. For an *Improvement in Swings;* Edward Maynard, City of New York, May 18.

*Claim.*—"Having thus fully described my invention, what I claim is, the combination of the wire frames, constructed as set forth, with the net work and swing cords."

42. For an *Improvement in Cotton Batting;* E. P. Rider, Brooklyn, New York, May 18.

*Claim.*—"Having thus described my invention, what I claim as new is, uniting two or more layers of cotton batting together, by means of any glazing material, thereby producing a new article of manufacture, which I term cotton felt, to be used for upholstery and all other purposes to which it is applicable, as herein set forth."

43. For an *Improvement in Churns;* Clarkson Rhodes, Morrow, Ohio, May 18.

"The nature of my invention consists in the manner I work the beaters or dashers, by a double belt cranked shaft, together with the method I employ, to suspend said beaters or dashers on their fulcrums."

*Claim.*—"What I claim as my improvement is, hanging the series of beaters or dashers by rods, extending from the shaft, the lower end of which rods supports the fulcrum, on which the beaters or dashers move, (not confining myself to the number or form of the dashers,) the said dashers being operated by the rods and bell cranks, substantially as herein forth."

44. For an *Improvement in Ovens;* Thomas N. Reid, Baltimore, Maryland, May 18.

"My invention consists in furnishing an oven, with all the characteristics of a baker's oven, with the addition of such fixtures as are necessary for cooking, heating water and air for household purposes; the utility of an oven of brick, such as used by professional bakers, heated conveniently, need not here be enumerated, while the advantages of combining therewith, cooking apparatus for domestic use, are incalculable."

*Claim.*—"Having thus fully described my improved oven, with cooking apparatus attached, what I claim therein as my invention is, the construction of said oven, with recesses on the side or sides for fuel, substantially as set forth above, and in combination therewith, the cooking chambers as herein described."

45. For an *Improvement in Hay Rakes;* Charles R. Soule, Fairfield, Vermont, May 18.

*Claim.*—"What I claim as my invention is, so constructing revolving spring tooth rakes, as to bring the centre of revolution nearer the lower ends of the teeth, than can be done by having them revolve on the head around which the teeth are coiled, (which is the usual mode,) by which means I cause them to revolve much quicker, and in going a much shorter distance than otherwise can be done; while at the same time they revolve much easier and more readily, in consequence of having the second head, coil, &c., to balance, or nearly so, the remaining heft of the teeth, &c., which will be on the other side of the centre of revolution, or nearly so; thereby giving the required length and elasticity to the teeth, with a quick and easy revolution, which I accomplish as herein set forth, or by means analogous thereto."

46. For an *Improvement in Cements;* B. S. Welch, Brooklyn, New York, May 18.

*Claim.*—"Having thus described my invention, I claim the primary cement herein described, formed of the hydrate of lime, in a finely subdivided state, and resin in a finely subdivided state, mixed together with water in a cold state, for the purpose set forth."

47. For an *Improvement in Machines for Making Fuses;* Albert F. Andrews, Avon, Connecticut, May 25.

*Claim.*—"What I claim as my invention is, passing the hollow mandrel through the winding spools, in combination with the flyers, which direct the winding thread from the

different spools to the interior of said mandrel, for the purpose of winding the fuse as it passes from the forming machine, when combined substantially as herein described."

48. For an *Improvement in Locomotive Boilers;* James W. Farrel, Reading, Pennsylvania, May 18.

*Claim.*—"What I claim as my invention is, isolating the lower portion of the water space surrounding the furnace from the upper portion, and connecting it by a free and constantly open communication with the tank of feed water, in such manner that the feed water of the tank will circulate without being forced by a pump in contact with the fire plates, to cool them, and to be itself heated, preparatory to being pumped into the boiler, substantially as herein set forth."

49. For *Improvements in the Tumblers of Locks;* Henry Blakely, City of New York, May 25.

"My invention consists in an improved construction of tumbler locks, and in the manner of operating them; in the finer sort, those intended for affording the greatest possible security, very skilful workmanship is required to obtain that extreme accuracy in the construction of the various parts which is essential to their successful operation."

*Claim.*—"What I claim as of my own invention is, firstly, the employment of tumblers in such combination with the bolt of the lock, that each and every tumbler, independent of the others, shall have freedom to move laterally, as well as vertically, whereby a great number of positions may be assumed by their unattached ends as described.

"Secondly, I claim the guide pieces upon the key, for the purpose of controlling the lateral motion of the tumblers as described; the whole being constructed and operating, substantially in the manner and for the purpose herein set forth and described."

50. For an *Improvement in Watch Chain Swivels;* W. B. Carpenter, Assignor to W. D. Salisbury and S. Y. D. Arrowsmith, City of New York, May 25.

*Claim.*—"What I claim as my invention is, making the joint of the opening piece *i*, oblique to the eye, so that it will open obliquely to the hook piece *a*, or *b*, in the manner and for the purpose herein set forth."

51. For an *Improvement in Mortising Machines;* John B. Chambers, Pittsburg, Pennsylvania, May 25.

*Claim.*—"Having fully described my several improvements, and sufficiently so for the better illustration of the former, the parts (not new) connected therewith, and constituting in combination the machine, I desire it to be understood that the main principle of action involving reciprocating chisels, and by a ratchet wheel feeding on the timber, is not by any means new; nor do I claim such, these being well known and common to other mortising machines; nor yet do I claim reversing the chisel; neither do I claim, separately of themselves, the device by which I effect my improvements: but what I do claim as my invention is, 1st, the employment of a stop catch, or hook, operated on by the reach arm, or pawl, to prevent the momentum given to the ratchet wheel from throwing the pawl out from between the teeth, after having performed its pull, and so making irregular the feed, one of the ratchet wheel teeth being beveled or reduced, in order to admit of the pawl entering sufficiently deep to arrest the motion of the feed, in the manner and for the purpose set forth.

"2d, The combination and arrangement of the stud, clutch arm, lever, cam, and stop, so that when the lever is thrown in, the cam will unclutch the machine, when the chisel crank is on the full centre, and the chisels are out of the work, and retain them in that position by the clutch coming in contact with the stop; the several parts being made, arranged, and operated in the manner herein fully set forth."

52. For an *Improvement in Stone Dressing Machines;* Simon W. and Reuben M. Draper, Boxborough, Massachusetts, May 25.

*Claim.*—"What we claim as our invention is, hanging the arm carrying the pick upon

a shaft, which receives a vibratory motion through a cam, driven by a mill spindle, or other spindle provided for the purpose, and giving the said arm a motion lengthwise along the said shaft, substantially as and for the purpose herein described."

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53. For an *Improvement in Swivel Hooks;* Albert and Morris Falkenau and Moris Pollak, City of New York, May 25.

*Claim.*—"We do not claim to have invented any one of the parts described and shown, as these in themselves, separately, are not new; but we do claim the combination of the spring, and its inclosing slide, with a swivel hook, for the purposes and as described and shown."

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54. For an *Improvement in Worm Tubs for Stills;* George Johnston, Farmington, Iowa, May 25.

*Claim.*—"What I claim as my invention is, the division of the worm tub into an upper and a lower compartment, and connecting them to each other by a valve, so arranged that it will be operated by the influence of the temperature of the water in the upper compartment, for the purpose of enabling the distiller to keep the water in the said upper compartment at any elevated temperature that may be required for use, in preparing the distiller's beer, or fermented wash, or for other purposes in the distillery."

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55. For an *Improvement in Flour Bolts;* David Marsh, Fairfield, Connecticut, May 25.

*Claim.*—"I do not claim to be the first to use a flat sieve or bolter, to separate substances of different sizes; what I do claim as new and of my own invention is, the construction, arrangement, and combination of the shafts and cranks 3 and 6, to receive and move the bolter *c*, with the cranks 7 and 8, and connecting bar *a*, or their equivalents, as described, to regulate and equalize the movement, the coarser particles being carried off from the bolter *c*, by the flexible tube *f*, or other convenient means; the whole being substantially as described and shown.

"And I claim the application of the breakers or spreaders *d*, in the bolting box *c*, to prevent the material working off too fast, and spread it evenly over the sieve or bolter *e*, as described and shown."

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56. For an *Improvement in Lubricating Oils;* William H. Mason, Boston, Massachusetts, May 25.

*Claim.*—"Having described the character of my invention, I will state that I am aware that spirits of turpentine and carbonate of potash have been used before my invention, in lubricating compounds, and I do not, therefore, claim them, except as specific agents to accomplish a definite and specific purpose stated in the specification; what I claim as my invention is, the combination of a mixture of camphene and benzole, carbonate of potash and glycerine, with whale or other cheap oil having similar properties, in the manner and for the purposes set forth."

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57. For an *Improvement in Hominy Machines;* Samuel Hull, Carroll County, Maryland, May 25.

*Claim.*—"What I claim by my invention is, the combination of the beaters *c, c*, with the beaters D D, each set moving in opposite directions, as set forth in the foregoing specification, substantially and for the purposes therein noticed."

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58. For an *Improvement in Railroad Car Trucks and Brakes;* E. G. Otis, Bergen, New Jersey, May 25.

*Claim.*—"I do not claim the winding of the chain around the axle, for the purpose of pressing the shoes against the wheels; neither do I claim the clutch, nor the collar, separately, for they have each been previously used; but what I do claim is, 1st, the method of operating the toggle joint, by means of the rod, having the cam upon it, which works in a slot in the bar, by which the clutch is thrown in and out of gear, or the cap made to

bear against the hub of the wheel, in combination with the compensating joints constructed in the manner and for the purpose as shown and described.

"2d, I claim the employment of the guards, vertical studs, and rods, arranged as described, for the purpose of enclosing the wheels and prevent them getting off the track, in case of the breakage of a wheel or axle, in combination with the arms and bolts, by which the trucks are suspended to the car bed, in the manner and for the purpose as herein specified."

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59. For an *Improvement in Cooking Apparatus;* Joseph Smolinski, City of New York, May 25.

"The points in which I claim to have made improvements are, the enveloping the centre of the stove or furnace, (as, for instance, the oven, or place for cooking,) with the smoke flues, carrying them up and down upon each side, and above and beneath, so that all the caloric in the smoke may be absorbed, before it passes out at the chimney; and, secondly, the combining with the stove, an easy and efficient mode of ventilation."

*Claim.*—"What I claim as my invention is, 1st, The peculiar arrangement of the smoke flues, as shown in figures 13 and 14, by which they are made to envelope the centre on all sides, and thus concentrate them in the smallest possible space.

"2d, The combination with this machine, of the key and valves, for ventilation and supply of air to the furnace from the room as above described."

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60. For an *Improvement in Cast Iron Car Wheels;* Stephen Thurston, Scranton, Pennsylvania, May 25.

"This invention consists in connecting the hub and rim, by a single plate of a peculiar form, which I consider well adapted to stand the shrinkage, in cooling, and to withstand the jarring to which all wheels are subject in running, and which presents no difficulties in moulding."

*Claim.*—What I claim as my invention is, constructing the hub and rim of a solid cast iron railroad wheel, by a single plate, having two series of radial corrugations, substantially as herein described."

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61. For an *Improvement in Machines for Jointing Staves;* Dennison Woodcock, Independence Centre, New York, May 25.

*Claim.*—"What I claim as my invention is, jointing the staves by means of cutters set at an inclined position, and converging towards one another in the front, the said cutters having a motion given them perpendicular to the stave, for formation of the bilge, or varying width of the stave, by means of the cam, the framing, and their accompanying parts, or devices equivalent thereto, operating substantially as specified."

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## Re-issue for May, 1852.

1. For an *Improvement in Apparatus for Parti-Coloring Yarn;* Alexander Smith, West Farms, New York; dated June 18, 1850; re-issued May 11, 1852.

*Claim.*—"What I claim as my invention is, the method substantially as specified, of parti-coloring yarns that have been reeled by direct and free immersion by means of frames carrying the reeled yarns, and combined with the vat containing the dying liquor, by means of machinery adapted to let down and draw up the said frame, and measure the extent of immersion, substantially as set forth.

"I also claim, connecting one or both of the reels in each frame by means of slides, to admit of removing the reel from contact with the yarns, whilst in the process of dying, substantially as specified."

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## Designs for May, 1852.

1. For a *Design for a Cooking Stove;* Apollos Richmond, Assignor to A. C. Barstow & Co., Providence, Rhode Island, May 11.

*Claim.*—"What I claim as my production is, the new design, consisting of the ornamental sheaf work, vine and flower work, &c., herein above described and represented in the drawings, for the front, side, and back plates of a cooking stove."

2. For a *Design for a Cooking Stove;* Hosea H. Huntley, Assignor to David D. Woodrow, Cincinnati, Ohio, May 11.

*Claim.*—"What I claim as my invention is, the design and configuration of the ornamental stove, all in combination, as herein substantially specified and represented in the accompanying drawings."

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3. For a *Design for Cook Stoves;* Thomas A. Herrick, Boston, Assignor to Lemuel M. Leonard, Taunton, Massachusetts, May 18.

*Claim.*—"What I claim as my production is, the new design, consisting of the ornamental mouldings, ribs, and rays, herein above described and represented in the drawings, for the side plate of a cooking stove."

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4. For a *Design for a Cook Stove;* Nicholas S. Vedder and William L. Sanderson, Troy, Assignors to Peter J. Clute, Schenectady, New York, May 18.

*Claim.*—"What we claim as new is, the ornamental design and configuration of cook stove, the same as herein described and represented in the annexed drawing."

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5. For a *Design for Ladies' Hair Combs;* William Redheffer, District of Spring Garden, Pennsylvania, May 25.

*Claim.*—"What I claim as my invention is, the design and configuration of fancy combs, above described."

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6. For a *Design for a Towel Stand;* Nathaniel Waterman, Boston, Massachusetts, May 25.

*Claim.*—"I claim the ornamental design or configuration, substantially as represented in the drawings."

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JUNE, 1852.

1. For an *Improvement in Fountain Pens Holder;* Charles Cleveland, Middlebury, Vermont, June 1.

"By this improvement the inconvenience and interruption of dipping the pen in ink is avoided; and the pen, with a supply of ink in the fountain, can be kept in the pocket, ready for use, occupying no more space than the ordinary pen and holder."

*Claim.*—"What I claim as my invention is, the combination of the valves in a fountain pen, for the admission of air, and regulating the flow of ink, with the slide or buttons, and with the spring and slide, in the manner above described, or in any other substantially the same."

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2. For an *Improvement in Corn Shellers;* David Eldridge, Philadelphia, Pennsylvania, June 1.

*Claim.*—"What I claim as new and my improvement is, the combination of the conical concave wedge and the guard with the concave wheel, for shelling corn, as herein described."

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3. For an *Improvement in Railroad Car Wheels;* Nehemiah Hodge, North Adams, Massachusetts, June 1.

*Claim.*—"What I claim as new is, the construction of car wheels, the combination of the segmental ring and keys, constructed substantially as described, or their equivalents, for the purpose of facilitating the insertion of the ring or band of india rubber, or other elastic material, between the central portion and the rim of the wheel, and as a means of fastening or holding the whole together, as herein set forth and shown."

4. For *Improvements in Copying Manuscript;* John Jones, Clyde, New York, June 1.

*Claim.*—"What I claim as new is, 1st, The employment or use of the circular rack, which serves as a guide to the index, said rack having a rim attached to its under surface, and projecting outwards, with the necessary letters and characters stamped or placed upon it, corresponding to the type placed on the periphery of the horizontal wheel, as specified.

"2d, I claim placing or securing the type vertically to the periphery of a horizontal wheel, having a rotating motion, and also a motion in the direction of its axis, by which, with the aid of the rack and index, the required letters may be printed upon the paper, in combination with the roller, the levers, and the shaft, or other equivalent device, for the purpose of operating upon the cylinder and adjusting it, to allow for the different thickness of type on the wheel, as herein described.

"3d, I claim the employment of the cylinder upon which the paper is secured, said cylinder having a motion in the direction of its axis, and also a rotating motion, said motions being communicated to it by the devices as shown and described, or in any other equivalent manner."

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5. For *Improvements in Violins;* William S. Mount, Stony Brook, New York, June 1.

*Claim.*—"That which I claim as my improvement is, the construction of that portion of stringed musical instruments which receives the strain of the strings, when tightened in tuning, in such form or forms as will cause the line of that portion of the instrument to be lengthened instead of shortened, if the same be altered at all by the strain.

"I also claim the hollow backed violin, or other stringed musical instrument of similar character, constructed substantially in the manner herein set forth."

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6. For an *Improvement in Revolving Breech Fire Arms;* Henry S. North, Middletown, and Chauncey D. Skinner, Haddam, Connecticut, June 1.

*Claim.*—"What we claim as our invention is, the construction of the sliding crotch, substantially as described, to enable it to perform the double purpose of revolving the breech and wedging it up against the barrel; and the combination of the sliding crotch and guard lever, constructed and arranged as specified, by which the breech is rotated, wedged forward, and the gun cocked by one motion back and forward of the trigger guard, or its equivalent, substantially as above described."

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7. For an *Improvement in Smut Machines;* G. S. Peck, East Smithfield, Pennsylvania, June 1.

*Claim.*—"What I claim as my invention is, the arrangement in which the grain is fed in at or near the bottom of the cylinder, through which it is elevated, by means of spirally inclined beaters, and discharged through the passage or spout, in combination with the ascending blast from the fan or blower, the same being arranged and operated essentially as above set forth and described."

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8. For *Improvements in Power Looms;* Rensselaer Reynolds, Valatia Village, New York, June 1.

*Claim.*—"What I claim as my invention is, 1st, Connecting the rocker of each picker staff, made and operated substantially as specified, with the bed on which it rocks, by means of an interposed strap of leather, or other flexible substance, attached at the inner end to the bed, and at the outer end to the rocker, substantially as and for the purpose specified.

"2d, Forcing the shuttle binders inwards against the shuttle while boxing, by a gradually increasing force, by means of arms on a rocker, provided with a spring, which is acted upon by a pin on the connecting rod of the lay, substantially as described.

"3d, Securing the raw hide pickers to the inner face of the staffs, by means of a leather strap, or the equivalent thereof, embracing and binding the two together, substantially as described, to insure the firm union to resist the rapid blows, and to prevent pieces of raw hide from breaking and flying, as set forth."

9. For an *Improvement in Cast Iron Car Wheels;* Daniel R. Rall, Rochester, New York, June 1.

*Claim.*—"I do not claim the concave plates or sides of the wheel; nor do I intend to limit myself to the precise form of such plates connecting the hub with the rim or tread of the wheel. But I claim the partitions or braces connecting the rim or tread with the two plates or sides of the wheel, the said partitions or braces extending from the inside of the rim or tread radially, or nearly so, part of the distance towards, but not connecting with the hub, as herein fully set forth."

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10. For an *Improvement in Fire Escape Ladders;* John C. fr. Salomon, Georgetown, District of Columbia, June 1.

*Claim.*—"What I claim as new is, forming or constructing a ladder with each successive step, from the end or ends, longer than the one preceding it, and connecting said steps with each other by links made fast at one end to each step, and the other end sliding through eyes in the step above or below, so that the steps can all fold closely together, in the manner substantially as described."

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11. For *Improvements in Looms for Weaving Piled Fabrics without the Figuring Wires;* Robert W. Sievier, Cavendish Square, England, June 1, 1852; patented in England, September 5, 1844.

"My invention consists, 1st, in a peculiar mode of producing and raising the terry or loops of such fabrics as Brussels carpeting, coach lace, velvets, or other similar fabrics, and which are woven by me, without the aid of intervening wires or tags, as commonly employed, to form such terry or loops, or raised surfaces; and, 2d, in certain improvements in looms, in order to render the same more capable of effecting that object."

*Claim.*—"Having now described the particular feature of my improvements in looms for weaving, and the mode or method of producing plain or figured goods or fabrics, I desire it to be understood that I claim as my invention, 1st, The novel mode or method of producing plain or figured goods or fabrics, having terry or looped surfaces of the kinds above described, by partially beating up certain picks of the shoot or weft threads, and afterwards further beating up or driving home those picks or shoots, in order to cause certain portions of the terry warp to pucker up in loops; but I do not confine myself to any particular number of picks or shoots of weft, but have described a method by which my improvements in producing plain or figured goods or fabrics, having a terry or looped figure, may be accomplished, as the number of picks or shoots of weft may be varied, to produce a different appearance in the face of the fabrics woven under my patent, according to the desire of the weaver.

"2d, I claim varying the forward stroke of the batten, to produce the open or close beating up of the weft, substantially as described, in combination with the apparatus for holding the surface threads or yarns, and carrying them forward in the manner described, or any other substantially similar, for the purpose of aiding in forming, in the loom, the loops of terry fabrics."

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12. For an *Improvement in Vertical Trip Hammers;* Peter Stebbins and John Holmes, Schenectady, New York, June 1.

*Claim.*—"We are aware that vertical trip hammers, elevated by friction rollers, are not new; neither are cams for regulating the elevation to which such hammers shall be lifted; and therefore we do not claim them: but what we do claim as our invention is, 1st, The recessed rollers in combination with the plain rollers and springs, or their equivalents, for controlling the operation of the lifting rollers; the projections on the said recessed rollers causing the shaft, lifting roller, and plain rollers to recede or move from the rollers on the shaft, and thereby allow of the hammer to fall; the whole being constructed, and arranged, and operating substantially as herein described.

"2d, The manner herein described of regulating the blow of the hammer, by making the recesses in the periphery of the rollers of unequal lengths, and making the said rollers movable on their shaft, so that either projection can be brought opposite to and made to act in combination with the plain rollers in the manner herein set forth."

13. For an *Improvement in Machines for Turning and Polishing;* Benjamin J. Tayman, Philadelphia, Pennsylvania, June 1.

*Claim.*—"What I claim as new is, the arrangement of a polishing belt for polishing circular surfaces in such manner that a bight of it shall pass round the article to be polished, and move concentrically, or nearly so, to the surface thereof, so as to finish the same rapidly, and without the danger of making flat places in its periphery, which is always so imminent when a round article is polished, by bringing it in contact with a polishing surface moving in a straight line.

"I likewise claim the combination of the rotating tubular cutter, for turning the rod with the polishing belts, which, while polishing one end of the rod, grasp it firmly and hold it from turning, while its other end is under the action of the cutters, as herein set forth."

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14. For *Improvements in Engraving Surfaces;* Isaac Taylor, Stanford Rivers, England, June 1, 1852; patented in England, February 21st, 1849.

*Claim.*—"What I claim as my invention is, 1st, The connecting of rhomboidal frames or pentagraphs in series, so as that the one which first receives a movement from the hand or other moving power, conveys its movement to a second, and this again, if required, to a third, and so on as far as the nature of the work to be done may need a high diminution to be carried."

"2d, I claim as my invention the placing of rhomboidal frames or pentagraphs in pairs, so connecting each pair by a rod or bar, at the working joint of each, as that a true geometric point of movement is presented upon every point or spot of such rod or bar, whether the said rod or bar be made to communicate motion to the cutting or other tools which act upon a fixed surface, or whether it be made to communicate motion to the surface itself, either plane or cylindrical, while the tools are fixed. These tools, which may be of any number convenient to apply, or required by the work, may be diamond or steel points, gravers, punches, drills, pencils, pens, or tubes for conveying colors.

"3d, I claim as my invention, the conveying the movement of the above mentioned rod or bar connecting two pentagraphs, to a cylinder or roller, in such manner as that when points or tools of any required kind are applied to the surface of the same, and in whatsoever direction, whether vertically or on the sides horizontally or beneath, each point or tool brought into contact with the cylinder, produces thereupon the same figure or mark of whatever kind which it would produce, if operating upon a plane surface.

"4th, I claim as my invention, the construction of a frame, called in my specification a ruling board, which, by transferring the weight of a loaded cylinder alternately from the sides or bearers of an external and internal frame, allows each frame in its turn to move backward or forward a distance regulated by screws or other similar means. In this manner, and by the application of a carriage or traversing point to one of these frames, lines may be ruled or engraved, with perfect accuracy as to their distance one from the other."

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15. For an *Improvement in Processes of Manufacturing Gutta Percha;* John Rider, City of New York, June 1.

*Claim.*—"What I claim as new is, the preparing of gutta percha for vulcanizing, by a preliminary separate heating of it to such a degree, as to expel its volatile ingredients herein specified, which I find can generally be effected at the high temperatures from 285 to 430 degrees Fahrenheit, substantially as herein set forth.

"I also claim the process herein described, of vulcanizing gutta percha, by first heating it to a sufficiently high temperature to expel from it the volatile ingredients herein specified, which it is believed can be accomplished between 285 and 430 degrees Fahrenheit, and then incorporating with it, substantially as herein specified, a hyposulphite, either alone or in combination with metallic sulphurets, or whiting, or magnesia, or with all of them together, and then subjecting the mixture to a temperature of from 285 to 320 degrees Fahrenheit; all the steps of the said process being performed substantially in the manner herein set forth. At the same time, desiring it to be understood that I disclaim the vulcanizing of gutta percha in all cases, save when it has been prepared for the vulcanizing operation by the aforesaid preliminary heating."

# LAW REPORTS OF PATENT CASES.

Reported for the Journal of the Franklin Institute.

## Woodworth Planing Machine Cases.

*Sloat* vs. *Patton*. *Sloat* vs. *Winslow*. *Wilson* vs. *Snowden*. *Wilson* vs. *Ashton*.—*Motions for Special Injunctions.*

Before Hon. John K. Kane, holding Circuit Court for Eastern District of Pennsylvania.

These were four cases in equity heard during the April Sessions of the Court, on bills and affidavits upon application for special injunctions. The complainants in the several bills were the assignees of the exclusive right to use the planing machine of William Woodworth, for the extended term of the patent, within the County of Philadelphia.

The infringement complained of in the first of the above suits, Sloat *vs.* Patton, was alleged to consist in the use of a planing wheel of a nearly disk form, slightly inclined in its plane of revolution to the plane of the board to be operated upon. The planing knives were so placed in this wheel, that when it revolved the edge of those knives generated the surface of an obtuse cone. It was stated by the complainant, that the board to be planed was controlled by pressure upon its surface by means equivalent to those described in Woodworth's Patent; that this defendant thus employed a combination of pressure rollers with rotating knives, substantially the same as described in the Woodworth Patent. It was further alleged, that the machinery employed by this defendant to tongue and groove the boards, was an infraction of another claim of the same patent. This machinery consisted of elliptical saws or plates, placed on vertical axles in an inclined position to such axles, so that the teeth of these elliptical saws or plates would describe the convex surface of a cylinder when the plates were revolved. It was further said, that the means of controlling the board, while under the action of the tonguing and grooving wheels, were analogous to those patented.

The Court declined hearing argument from the defendant on the validity of the Woodworth Patent at this stage, referring to previous trials and investigations in that Court as having determined that question. The defendant denied that the machines used by him infringed upon any claim of the complainant's patent. He asserted and read affidavits to establish the fact, that the planing wheel employed by him was a simple disk, and described in its revolution a plane parallel with the face of the board, and not the surface of a cone. He said that in his machine pressure to control the board was neither used nor required to be used. His tonguing and grooving tools, he insisted, were entirely unlike in form and principle of operation to the cutters of Woodworth. Many affidavits of a contradictory character were read on both sides, and Professor Byrne was examined orally on behalf of the defendant, and Harvey Waters on behalf of the complainants.

The machines used by Winslow and by Ashton, the defendants in the second and fourth of the above suits, it was alleged by the complainants, bore a still closer resemblance to those patented by Woodworth. It was

contended that the tonguing and grooving apparatus in these machines was identical with that of Woodworth, and that the planing wheels employed by these defendants were so placed as to describe a more clearly perceptible cone than in Patton's machine. On behalf of these defendants, it was admitted that the tonguing and grooving tools were similar to those of Woodworth; but it was insisted that the planing wheel did not describe a conical surface, and that pressure was neither required nor used while the board was being planed.

Two bills had been filed against Snowden, the defendant in the third suit,—one was filed by J. P. Wilson, as assignee of the Woodworth patent, and the other by J. P. Wilson, as assignee of the Barnum planing machine patent. It was complained that Snowden infringed on the Barnum patent, by using the precise machine described and patented by Barnum for planing; and that he infringed on the Woodworth patent by using the same tools and combination in tonguing and grooving as were described therein. The latter infringement was not denied by the defendant during the argument, but it was contended that the defendant had acquired a right to use the Barnum machine, by virtue of a license from Barnum, the former owner of the patent, and subsequently it was contended that he had acquired this right by the purchase of a machine from Barnum. The complainant denied that any valid title was acquired by Snowden in either manner as alleged.

During the course of the evidence, affidavits stating that the complainants had been unable to obtain access to examine the respective defendants' machines were read, and application was made to the Court for an order of inspection. Whereupon the following order was made:—

"That the respective defendants do permit an inspection and thorough examination by Harvey Waters, on behalf of the complainants in the above cases, of the planing, tonguing, and grooving machines in controversy, in each case respectively, and that the said expert be permitted to bring any specimens of the work done by the said machines; and that the said machines shall be worked by the servants of the respective defendants as the said Harvey Waters may request."

Mr. Waters afterwards was examined in Court as an expert, and exhibited specimens of the boards planed at the several machines. In the course of the trial, a very ingenious working model of a planing machine was introduced into Court by the last named expert. Its essential feature was a Woodworth planing cylinder, so constructed and arranged that while the operation of planing was going on, this cylinder could be altered to a cone or to a disk, and vice versa.

The four cases were argued at the same time. Mr. Campbell, Mr. Keller, and Mr. Harding appeared for all the complainants, and Mr. Cuyler appeared for all the defendants. Mr. Hubbell also appeared for Patton, and Mr. Taylor for Winslow.

The Court having taken time to consider, delivered the following opinion on the 28th of May last, granting injunctions in all the cases as prayed for.

OPINION.

The effort to smooth boards and reduce them to a uniform thickness by the rotary action of cutter knives set in the face of a disk, and made

to revolve in the plane of the intended surface, is of ancient date. But from the time of Bramah, half a century ago, until now, it has never been successful.

If it were practicable to construct a machine, mathematically accurate in all its parts, and of inflexible material, so as to prevent all possible vibration; and if, besides, the wood to be operated on could be first deprived of all its elasticity, then each cutter as it passed on its way, removing a certain portion of the board, would leave the surface absolutely finished behind it—and the other cutters and the same cutter returning in its revolution, all following in absolutely the same plane with the first, would pass over the finished surface, neither abraiding it nor compressing it, yet in contact with it.

But these conditions involve mechanical impossibilities. The strongest engine that ever came from the shops, vibrates sensibly when it encounters an intermitting resistance, and there is no such thing as a non-elastic. The practical consequence is, that the cutters after finishing their work, still continuing to revolve over the smoothed surface, will sometimes be impelled for the instant below the plane of their normal action; and on the other hand, the board partially compressed when under the action of each cutter in succession, but rising again immediately afterwards by its own elastic force, will present a new surface to be acted on by the next cutter—that surface varying in height according to the varying density and consequent elasticity of the board. This is illustrated by the *back-lash*, an irregular trace made on the finished surface by the cutters that continue to pass over it.

Woodworth was the first to propose a remedy for this, by placing his cutters on the periphery of a rotating cylinder, while he presented the face of the board in the tangent plane of their revolution. He thus prevented the cutters, while the board was moving, from tracing it a second time, and gave the *dip and lift cut* which has been so often recognised as the characteristic of his patented machine.

It is obvious that to make this cut, it is not necessary to place the cutters on a true cylinder. A cone, or even a dished wheel, scarcely deviating in appearance from a true disk, will produce the same effect, provided the board approaches and leaves the cutters in the tangent plane of their revolution. I had no difficulty, therefore, when the cases of Plympton and Mercer and others were before me, some years ago, in holding that a cone or dished wheel so arranged, was simply a mechanical equivalent for the cylinder of Woodworth; and the rulings then made, have, on more than one occasion since, received the sanction of both the judges of this Court.

Strange to say, in three of the cases now before me, the principal dispute has been as to the fact, whether the machine used by the defendants is or is not a *disk*, or, as it has been spoken of in the argument, a Bramah wheel. Numerous witnesses, some of them highly respectable, have testified that it is nothing else—and that its cutters move of course in the same plane, and parallel with the lower face of the board—in other words, that the cutting disk coincides in its revolutions with the finished surface. But it is as certain as any truth in the philosophy of mechanics, that in this they are mistaken—for the machine in its ordinary working

leaves no back-lash, and the boards that were passed through it by one of the gentlemen who inspected it under the Court's order, show unequivocal marks of the dip and lift cut.

Neither witness nor counsel has explained how a disk which all describe to be like Bramah's wheel, and worked as his was, can produce results so different from his; nor how it happens that the results produced by it are so precisely those which would be produced by cutters revolving on a flattened cone. On the contrary, all admit that the machine does vibrate, and that the boards which it commonly works on are damp, if not wet, and of course easily compressed under the cutters. It is to exact more than a reasoning faith in human testimony, to assure us that such a machine acting on such a material, will in the hands of the defendants renounce the mechanical law which it has been exemplifying every where else for the last fifty years.

It is true, that upon *tramming* the disk with the bed plate, in order to test their parallelism, the defendant's witnesses observed no deviation from the disk form. But though this were so, yet in just such a disk the cutters might be arranged in such a manner as to describe a cone when revolving; and Mr. Patton's cutters were not, and probably could not be trammed. Besides which, the axis of the disk was so adjusted at its upper extremity, as to give it at pleasure the oblique action which is adapted to the revolving cone, and yet to restore it again in a few minutes, with the disk parallel to the bed plates.

When we consider that the machine while at rest can have its character thus easily modified, so as to give proof for the time of the parallelism of its parts, if such proof be desirable, and that while in motion, it defies all scrutiny, revolving, it may be, some 3000 times in a minute, and its three cutters therefore following each other with an interval between them of but the 150th part of a second; and that an obliquity in the disk, not exceeding the $\frac{1}{16}$-th of an inch on its cutting diameter, would be sufficient to change its effective action; we can apprehend without difficulty that the defendant's witness may have fallen, very honestly, into error. But it is enough for us to know, that according to the laws of matter and motion, which are the condensed expression of all mechanical experience, the machine, as they describe it, cannot produce the effects, which we see that the machine produces in fact. The foot print on the sand indicates with less certainty the form and pressure of the foot that made it, than a curved cut on the face of a flat board proves a corresponding curvature in the path of the cutting tool.

It is in vain to refer us for an explanation to the abnormal influences of vibratory or semi-elastic forces, without showing us what those influences are, and how they resolve—they resolve for the time a disk into a cone, or enable the machinist to trace a regulated curvilinear surface by the rectilinear movement of a plane. This is only to reassert the paradox in more general language, to prove the controverted fact by reference to an unknown theory.

I must hold, therefore, that the planing machine of Messrs. Patton, Ashton & Winslow, and Ashton & Beer, are essentially the same with the planing apparatus of the Woodworth patent.

The machine employed by Mr. Patton, and, as it is said, invented by

him, for cutting the tongue and groove, is spoken of as an elliptical saw. It consists of a revolving saw plate of lozenge shape, set at such an oblique angle as to make all the teeth on its periphery equidistant from its action of motion. In revolving, it describes, of course, a cylinder, and its action is that of a rasp. It does not divide the board as a saw does; but performs the office of Woodworth's duck-bill cutter, somewhat less perfectly, and apparently at greater cost. The only points of difference are that what would be the one cutter of Woodworth is, in Mr. Patton's machine, effectively divided into several, so as to form a series of cutting disks or saws, the teeth of which abrade in succession the portions of the board to be removed, leaving the edges rough in consequence, instead of giving them the comparatively smooth surface of the Woodworth machine; and that while a broken cutter can be removed from the Woodworth disk, and a new one substituted, a tooth broken from Mr. Patton's saw destroys it. Whatever, therefore, may be the supposed interest or novelty of the elliptical saw, it must in its adaptation to this particular use, be regarded as embodying the principle, and constituting, but for its inferiority, the mechanical equivalent of Woodworth's cutting wheel.

The tonguing and grooving apparatus of the Ashton and Winslow, and Ashton and Beer machines, are confessedly those of Woodworth's patent.

The same is true of Snowden's; and his planing machine is an equally direct piracy of the Barnum patent, now held by the complainant.

I have not, in this opinion, discussed the question of the validity or the extent of Woodworth's patent. These have been so often before almost all the Courts of the United States, as to make them inappropriate topics for interlocutory argument. There must be at some time or other an end of controversy as to the character of a patentee's property in his invention; and now that twenty-three years have gone by since the Woodworth patent was issued and passed into litigation, I am disposed to recognise its parting claim to repose; *solve senescentem.* I therefore limited the discussion at its outset to the single question of infringement.

I have one more remark to make, it is prompted by a review of the devices employed by these defendants and those who have gone before them in similar controversies. I cannot but think that the time has come, when, in this District at least, the attempt to mask an infringement of this particular patent should be almost regarded as a waste of ingenuity. It is a truth of large acceptation, both in policy and morals, that it is better in the long run to strive patiently for a legal property of one's own, than to persist in trespassing on the property of others. The invention which is set forth in letters patent *belongs* to the inventor—as rightfully as the house he has built or the coat he wears. It cannot detract from the dignity of his title, that the subject of it is of his own creation, his thought conceived and developed and matured in the recesses of his mind, that it has cost no man else any thing, and asks nothing in return for the contribution it makes to the general wealth and happiness, but that security of enjoyment, during a limited period, which the laws engage for all other property without limitation of time, and without stipulating a price. It would be a reproach to the judicial system, if an ownership of this sort could be violated profitably or with impunity.

The complainant's counsel will prepare the draft of decretal orders in he several cases in accordance with this opinion.

# MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

## *Inconsistency and Error of the Conclusion arrived at by a Committee of the Academy of Sciences of France, agreeably to which, Tornados are caused by Heat; while, according to Peltier's Report to the same body, certain Insurers had been obliged to pay for a Tornado as an Electrical Storm. With Abstracts from Peltier's Report.* By Dr. Hare.

In the 2d series of queries proposed to Mr. Espy, published in the May number of this *Journal*, allusion is made to the report signed by Arago, Pouillet, and Babinet, three distinguished members of the Academy of Sciences of France, sanctioning the idea that tornados are due to the heat of condensing vapor, when agreeably to a report made under the auspices of Arago, the President of that Academy, less than two years before, certain insurers had been obliged to pay for a tornado as an electrical storm.

It is remarkable that Arago, one of the most distinguished electricians in Europe, when requested to decide this question, did not conceive himself warranted in saying whether or not a tornado was an electrical storm. Had the damage been done by lightning, there would have been no doubt as to the nature of the cause; but as it was done by the meteor above mentioned, (called trombe in French,) Arago felt it necessary to send Peltier to examine the phenomena, in order to find out whether or not they were due to electricity. It had often been observed that electrical phenomena were attendant on such storms, and by some observers they had been ascribed to electricity; yet so vague and unsatisfactory had been the evidence or arguments in favor of this view of the question, that they seem to have made no impression on the minds of the sagacious, learned, and ingenious members of the "Academie des Sciences."*

Such, at all events, is the only inference which can be reasonably drawn, judging from the opinions expressed by those among them, who were selected as eminently competent to decide.

It is manifest that Arago had formed no opinion, or he would not have sent Peltier to investigate the phenomena, in order to determine the question. As this philosopher, Pouillet, and Babinet, were chosen as a committee to decide on Espy's theory of tornados, it is to be presumed that they were considered as among those members who were pre-eminently qualified to judge, respecting meteorological theories. Let us then see

*Among those who alleged them to be due to electricity, Beccaria is, perhaps, the most distinguished; but how little he understood the true nature of the meteor, is manifest from his crediting the allegation that they could be dissipated by the presentation of a sword from the deck of a vessel. Evidently no vessel could come within the electrified column without being dismantled, if not wrecked; and if situated outside of the electrified column, how could the electricity reach the sword? But should it be induced to leave its wonted vertical path, in order to pass off by this weapon, how could the person presenting the sword survive an influence capable of rending the wood of trees into laths, as alleged by Peltier?

whether any of the other academicians were, more than Arago, impressed with the idea that electricity was the main cause of tornados.

I subjoin the opinions of Pouillet first.

"*How can this power, sometimes so prodigious, be created in the midst of the sky?* This is a question to which, it must be admitted, science as yet cannot give a precise answer. Of all the vague and hazardous conjectures which have been made respecting the origin of this meteor, probably the least unreasonable is, *that it is a whirlwind of excessive intensity.* But the discussion of this point seems premature. It is necessary to multiply observations, and to compare with more precision all the attendant circumstances of the phenomena." *Pouillet Elemens de Physique Experimental et de Meteorologie.*

To allege a tornado to be a whirlwind, without showing how a whirlwind may be produced or sustained in the case in point, is only substituting one mystery for another. Whirling or gyration is an *effect*, not a *self*-moving power, as some meteorologists seem to suppose.

All the elucidation given by Depretz, another luminary belonging to the same illustrious Academy, is contained in the following language, which is a literal translation from his Traite Elementaire de Physique, page 329:

"*The tornado* ("*trombe*") *is seen upon the sea and upon the land. Sometimes it seems to come out from the bosom of the sea, ascending to the clouds; sometimes it descends from the clouds down to the earth.*"

"*It is a conical column of water, which revolves upon its axis, with great rapidity. The base is sometimes more than two hundred metres in diameter.*"

"*An idea may be had of tornados from the little whirlwinds of dust which suddenly form themselves in summer, revolving with great rapidity.*" Risum teneatis amici?*

That Babinet entertained no feasible idea of the part performed by electricity in the generation of the tornado, is evident; since, after a long discussion, in which no allusion is made to electricity as essential, he terminates with a conclusion favorable to the Espyan hypothesis, and in which electricity is referred to only as a subordinate participant playing a part, respecting which he shows himself incapable of throwing any light. I subjoin his "*conclusion,*" as he designates his ultimate brief exposition of those inferences which his study of the question led him to make.

I use the singular pronoun, his, because Arago assured me he had

* "Comment cette puissance quelque fois si prodigieuse peut-elle prendre naissance au milieu des airs? Cest une question, il faut le dire, à laquelle la science ne peut faire aucune réponse précise. De toutes les conjectures vagues et hazardées que l'on peut faire sur l'origine de ce météore la moins invraisemblable est peut être celle qui le regarde comme un tourbillon d'une excessive intensité. Mais une discussion sur ce point nous semblait prematurée, il faut multiplier les observations et constater avec plus de precision toutes les circonstances de ces phénoménes." Elémens de Physique et de Météorologie, Tom. 2, page 727.

Tous les détails que Despretz donne sur les trombes se trouvent dans ces paragraphes que j'emprunte à son traité de Physique.

"*Trombe.* La trombe se montre en mer et sur la terre; tantôt elle semble sortir du sein de la mer et s'élève jusqu'aux nuages; tantô elle descend des nuages jusqu'à tèrre.

Cest une colonne d'eau conique qui tourne sur elle même avec une grande vitesse; elle a quelque fois jusqu'à plus de deux cents mêtres de base. Elle est très-commune entre les Tropiques. Les navigateurs passent rarement près des côtes de Guinée sans en apercevoir plusieurs.

Les trombes produisent des effets terribles, elles déracinent les arbres renversent les faibles habitations soulèvent les voitures etc.

Ou peut se faire une idée des trombes par des tourbillons de poussière qui se forment tout-a-coup en été sur les routes et qui tournent sur eux mêmes avec une grande rapidité Traité Elem. de Physique, parag. No. 656, pag. 828.

nothing to do with the report, and Pouillet let it pass, because Arago could not attend, and he could not agree with Babinet; while Espy was very urgent to have the report before leaving Paris.

*Babinet's "Conclusion."*

"In conclusion, Mr. Espy's communication contains a great number of well observed and well described facts. His theory, in the present state of science, alone accounts for the phenomena, and, when completed, as Mr. Espy intends, by the study of the action of electricity when it intervenes, will leave nothing to be desired. In a word, for physical geography, agriculture, navigation, and meteorology, it gives us new explanations, indications useful for ulterior researches, and redresses many accredited errors.

"The committee expresses then the wish, that Mr. Espy should be placed by the government of the United States in a position to continue his important investigations, and to complete his theory, already so remarkable, by means of all the observations and all experiments which the deductions even of his theory may suggest to him, in a vast country, where enlightened men are not wanting to science, and which is besides, as it were, the home of these fearful meteors.

"The work of Mr. Espy causes us to feel the necessity of undertaking a retrospective examination of the numerous documents already collected in Europe, to arrange them, and draw from them deductions which they can furnish, and more especially at the present period, when the diluvial rains, which have ravaged the south-east of France, have directed attention to all the possible causes of similar phenomena. Consequently, the committee proposes to the Academy to give its approbation to the labors of Mr. Espy, and to solicit him to continue his researches, and especially to try to ascertain the influence which electricity exerts in these great phenomena, of which a complete theory will be one of the most precious acquisitions of modern science."

Mr. Espy is to study the action of electricity "*when it intervenes.*" Of course, it was only a visiter, according to Babinet's opinions.

Such was the state of knowledge respecting tornados in 1836, when I handed to Arago and other members, copies of my pamphlet, in which I attributed those awful meteors to a convective discharge of electricity in these words: "*After maturely considering all the facts, I am led to suggest that a tornado is the effect of an electrified current of air superseding the more usual means of discharge between the earth and clouds in those sparks or flashes which we call lightning.* While the air is thus carried up by the concurrent influence of electrical attraction and the reaction of its own previously constrained elasticity, other bodies are lifted both by electrical attraction and the blast of air to which it gives rise. Hence houses within the sphere of excitement are burst by the expansion of the air which they contain, their walls being thrown outwards and their roofs carried away, while by the afflux of the atmosphere requisite to the restoration of its equilibrium, trees, houses, and other bodies are thrown inwards towards the vertical current from before as well as from either side."

This rationale of the tornado had been in the hands of the academicians and the library of the Academy for about three years, when, agreeably to an article published at Paris, on July 17th, 1839, in the *Journal des Debats*, a tremendous tornado occurred about the last of the preceding month, at Chatenay, in the vicinity of that metropolis. The losers applied for indemnity to certain insurers, who objected to pay on the plea that the policies were against thunder storms, not againt tornados. This led to an application to the celebrated Arago, who referred the case to another savant, Peltier, as above stated.

From the following narrative, translated from his report, it will be seen

that Peltier adopted my opinion, that a tornado is the effect of an electrical discharge.

"Early in the morning a thunder cloud arose to the south of Chatenay, and moved at about ten o'clock over the valley between the hills of Chatenay and those of Ecouen. The cloud having extended itself over the valley, appeared stationary, and about to pass away to the west. Some thunder was heard, but nothing remarkable was noticed, when about midday, a second thunder storm, coming also from the south, and moving with rapidity, advanced towards the same plain of Chatenay. Having arrived at the extremity of the plain above Fontenay, opposite to the first mentioned thunder cloud, which occupied a higher part of the atmosphere, it stopped at a little distance.

* * * * *

"Up to this time there had been thunder continually rumbling within the second thunder cloud, when suddenly an under portion of this cloud descending and entering into communication with the earth, the thunder ceased. A prodigious attractive power was exerted forthwith, all the dust and other light bodies which covered the surface of the earth mounted towards the apex of the cone formed by the cloud. A rumbling thunder was continually heard. Small clouds wheeled about the inverted cone, rising and descending with rapidity. An intelligent spectator, M. Dutour, who was admirably placed for observation, saw the column formed by the tornado terminated at its lower extremity by a cap of fire; while this was not seen by a shepherd, Oliver, who was on the very spot, but enveloped in a cloud of dust.

"To the south-east of the tornado, on the side exposed to it, the trees were shattered, while those on the other side of it, preserved their sap and verdure. The portion attacked appeared to have experienced a radical change, while the rest were not affected.

* * * * *

"Finally, it advanced to the park of the castle of Chatenay, overthrowing every thing in its path. On entering this park, which is at the summit of a hill, it desolated one of the most agreeable residences in the neighborhood of Paris. All the finest trees were uprooted, the youngest only, which were without the tornado, having escaped. The walls were thrown down, the roofs and chimneys of the castle and farm house carried away, and branches, tiles, and other movable bodies, were thrown to a distance of more than five hundred yards. Descending the hill towards the north, the tornado stopped over a pond, killed the fish, overthrew the trees, withering their leaves, and then proceeded slowly along an avenue of willows, the roots of which entered the water, and being during this part of its progress much diminished in size and force, it proceeded slowly over a plain, and finally, at the distance of more than a thousand yards from Chatenay, divided into two parts, one of which disappeared in the clouds, the other in the ground."

"In this hasty account I have, with the intention of returning to this portion of the subject, omitted to speak particularly of its effect upon trees. All those which came within the influence of the tornado, presented the same aspect; their sap was vaporized, and their ligneous fibres had become as dry as if kept for forty-eight hours in a furnace heated to ninety degrees above the boiling point. Evidently there was a great mass of vapor instantaneously formed, which could only make its escape by bursting the tree in every direction; and as wood has less cohesion in a longitudinal than in a transverse direction, these trees were all, throughout one portion of their trunk, cloven into laths. Many trees attest, by their condition, that they served as conductors to continual discharges of electricity, and that the high temperature produced by this passage of the electric fluid, instantly vaporized all the moisture which they contained, and that this instantaneous vaporization burst all the trees open in the direction of their length, until the wood, dried up and split, had become unable to resist the force of the wind which accompanied the tornado. In contemplating the rise and progress of this phenomenon, we see the conversion of an ordinary thunder gust into a tornado; we behold two masses of clouds opposed to each other, of which the upper one, in consequence of the repulsion of the similar electricities with which both are charged, repelling the lower towards the ground, the clouds of the latter descending and communicating with the earth by clouds of dust and by the trees. This communication once formed, the thunder immediately ceases, and the discharges of electricity take place by means of the clouds, which have thus descended, and the trees. These trees, traversed by the electricity, have their temperature, in consequence, raised to such a point that their sap is vaporized, and their fibres sundered by its effort to escape. Flashes, and fiery balls, and sparks accompanying the tornado, a smell of sulphur remains for several days in the houses, in which the curtains are found discolored. Every thing proves that the tornado is nothing else than a conductor formed of the clouds, which serves

**as a passage for a continual discharge of electricity from those above, and that the difference between an ordinary thunder storm and one accompanied by a tornado, consists in the presence of a conductor of clouds, which seem to maintain the combat between the upper portion of the tornado and the ground beneath."**

Less than two years after the allegations and inferences comprised in the preceding abstracts were reported to the Academy, and after the insurers had been obliged, as *Peltier informed me*, to pay for it as an electrical storm, Babinet sanctioned the idea that the main cause of tornados is the heat imparted to an ascending column of air by condensing vapor, electricity occasionally intervening, but not being in the least essential to the generation or endurance of the meteor.

There is another narrative published in the *Comptes Rendus*, or Journal of the Proceedings of the Academy, which confirms that of Peltier in every essential particular. Both of these narratives agree with that which I had given respecting the tornado of New Brunswick, excepting that the chemical effects upon the trees appear to have been more violent at Chatenay.

Although Peltier made his report (of which abstracts have been given) three years after I personally handed my pamphlet to Arago and other members, leaving one in the library of the Academy, he alluded to my memoir only in order to show that he owed nothing to it. In the point of the greatest and most evident importance I had manifestly anticipated him. I allude to the inference, that during a tornado an electrical discharge takes place by means of the column or trunk, superseding the lightning by which, during ordinary thunder storms, discharge is effected. There is, *so far*, a perfect identity between his inferences and mine. These, with the facts established by the survey at New Brunswick, and by his own statements, shew that there can be no rational explanation of a tornado, but that of its being the result of a convective discharge. I am not in the least disposed to contest any honor which he may have acquired from so much of his explanations as are inconsistent with that given by me.

That the idea of Peltier that the cloud acts as a conductor is untenable, must be evident, since the light matter of which a cloud is constituted could not be stationary between the earth and sky in opposition to that upward aerial current of which the violence is admitted by him to be sufficient to elevate not only water, but other bodies specifically much heavier than this liquid.

Moreover, I have ascertained that dense fog produced within a glass vessel, does not act as a conductor so as to discharge an electrified knob of iron. When subjected to the exciting power of an electrical machine, the knob gave sparks as well when the fog was present, as when it was away. The knob was made red hot, to prevent the interference of condensing moisture.

But independently of this experimental evidence, were moisture in the state usually designated as fog or cloud a conductor, how could it issue from an uninsulated high pressure boiler highly charged with electricity? As soon as, by the escape from confinement, the pressure is relaxed, one portion of the steam is resolved into low pressure or rare steam, while another portion precipitating, assumes the state of the aqueous matter in a cloud.

The upward current of air, and the carrying up of movable bodies, which has been fully established to be characteristic of tornados, and of which Peltier himself confirms the existence, is irreconcilable with conduction, but is just what a carrying discharge would involve as a matter of course.

Subsequently to the publication of my memoir on the cause of tornados, in the *American Philosophical Transactions*, and *Silliman's Journal*, for the year 1837, Faraday distinguished that species of electrical discharge which takes place by a current of air, or by the movement of bodies situated between the electrified surfaces, and consequent alternate contact therewith, as the "*convective* discharge;" while the discharge by means of sparks or lightning were designated by him as *diruptive*.

The employment of these terms renders the demonstration of my rationale more easy to state. These modes of discharge have been witnessed by every person who has ever been present when the most common routine of electrical experiments has been exhibited, in which not only the spark is shown, but the dancing of pith-balls, or of puppets, the ringing of bells, the rotation of wheels, or the blasts produced by electrified points, causing such wheels to rotate.

It is notorious that either of these modes of discharge may be made to take place, by varying the distance, or the form or character of the masses employed.

Thus, in the experiment in which pith-balls are made to resemble hail, by dancing between oppositely electrified disks, an approximation of one of the disks towards the other induces a spark or diruptive discharge, and thus causes dancing to cease. In Cuthbertson's balance electrometer the movable ball approaches that which is stationary, in obedience to the convective process; but as soon as the distance between the balls is reduced within the striking distance, a diruptive discharge ensues, indicated as usual by a spark.

It follows that by a slight variation as to distance, the same degree of electrical excitement may be productive either of a convective, or of a diruptive discharge. Excepting a prodigious disparity in magnitude, the diruptive spark discharge is universally recognised as perfectly similar to lightning. Both the one and the other process are admitted to be due to discharges of electrical accumulations, differing only as to magnitude. Since, agreeably to this exposition, susceptibility of commutation exists, as respects diruptive discharge in its minuter forms, and convective discharge upon the same scale, does it not follow that the former, as produced by the gigantic processes of nature, should be commutable with a convective process of corresponding immensity? But if the spark be exemplified by lightning, how is the convective discharge to be exemplified? Where is there any gigantic meteorological process which can supply the deficiency, excepting that of the tornado or hurricane, which last may be viewed as a tornado on a scale of pre-eminent grandeur?*

*** Experience shows that the denser portion of the atmosphere, which lies between the storm clouds and the earth, is competent to act as an electric; since otherwise there would be no thunder gusts, nor any atmospheric discharges as displayed in the form of lightning. That air, rarefied to a certain degree, becomes capable of acting as a coating does in the instance of the Leyden jar, is proved by the fact that the inner surface of a glass globe, within which the air is rarefied by exhaustion, may be charged like a Leyden jar, if to the**

If from a point electrified by a machine, a blast of air may proceed as strong as from a blow-pipe supplied by a bellows, may not an enormous blast be emitted from every terrestrial prominence, electrified by the powerful apparatus of nature, as much greater than that of a blow-pipe, as a spark of lightning of a mile in length, exceeds that yielded by an excited conductor or charged jar? So long as there is an ascent of air consequent to electrical convection, there must be a confluence of the same fluid from two or more opposite quarters, to supply the deficit thus created; and the air as it follows the electrified column being successively similarly electrified, that enduring trunk or column is formed and sustained which characterizes tornados or water-spouts.

Within this traveling trunk, which, in its form, contortions, and deleterious power, resembles that of an enormous elephant, as mischievous as gigantic, bodies are not only subjected to the same convective influence as the air, but are also exposed to the upward force arising from a vertical blast. On each side of the track which marks the progress of the trunk, bodies are subjected to the confluent blasts, which rush in to supply the upward current.

The alternation of the convective and diruptive discharges was well exemplified in the phenomena of the Providence tornado of 1838, as described by a most worthy and well informed observer, Zachariah Allen, Esq. As soon as the trunk reached the river, the water throughout the included area, rose up as in a state of ebullition by the convective influence; but a diruptive discharge, in the form of lightning, taking place, the foam subsided momentarily, yet rose again, until by another spark of lightning another subsidence ensued. Were ever facts more accordant with an explanation than those observed by Mr. Allen, with the hypothesis which I advanced?

Against the idea that there could be any adequacy in the apparatus of nature, such as to make bodies dance between the earth and sky, as pup-

outer surface a conducting body be applied, and a due communication made with an electrical machine in operation.

As it is well known that the terrestrial surface is a conductor, it follows that in that surface, the denser air in proximity therewith, and the rarefied conducting air above, we have an electric between two conductors competent to act as coatings. Thus the dense air acts as a glass pane between two coatings, or as the glass in an exhausted globe acts between the rarefied air within and the hand of the operator without. We have, therefore, all that is requisite to the reception of an electrical charge.

That the means of disturbing of the electric equilibrium are abundantly prolific, the terrific discharges of lightning in electrical storms can leave no doubt.

Using the language of the Franklinian theory, I urged that, in the concentric spaces occupied by the earth and that occupied by the rare conducting medium above alluded to, there must be two oceans of electricity, which could not fail from mechanical or chemical causes to be in different states. But assuming that electricity is a result of the polarization of the ethereal fluid, to the undulation of which light is ascribed, we are led to substitute for oceans of a specific fluid, the idea of a boundless ocean of ethereal matter, which by peculiar affections may become competent to perform, within the concentric spaces alluded to, the part assigned by Franklin to one fluid, by Dufay to two fluids.

Consistently it may be inferred that an atmospheric charge may extend all around the globe, so as to make one great battery analogous to that above described of the exhausted glass globe; the rarefaction being in one case internal, in the other external. Agreeably to these considerations, there are no limits to the possible extent of atmospheric accumulations of electricity, while the rapidity with which discharges pervade conductors is such as to render distance no obstacle.

pets and pith-balls are seen to dance between electrified brass disks, it has been urged by Prof. Espy, that a stratum of an elastic fluid like air, could not perform the part of a solid metallic disk.

The answer to this is, that whatever state of things is competent to sustain electrical charges, is competent to produce any of the phenomena of *dis*charges. Just as much stability is requisite to enable the diruptive discharge of lightning to take place, as to enable the convective discharge of the tornado or water-spout.

To conclude, I claim to have laid before the scientific world a memoir, in which the tornado is made to bear the same relative position to lightning that the carrying discharge does to the electrical spark, and to have been the first electrician that ever pointed out this simple and true relation between those awful meteors. I urge that the language, proceedings, and reports of the French academicians show, that they were entirely unprepared for this new view of the subject. Hence, nearly five years afterwards, notwithstanding the tornado at Chatenay and Peltier's Report, and that I had sent them meanwhile a pamphlet containing a translation of my memoir into their own language, they still remained in utter darkness: but that meanwhile, Peltier, with the approbation of Arago, the President of the Academy, had adopted essentially my explanation; attempting, however, to put my theory in the back-ground, by substituting *conduction* for *convection*.

As I have elsewhere said, Franklin by aid of a kite-string demonstrated the identity of lightning with the electrical spark or diruptive discharge. I hope to have shown, by reasoning and a reference to experimental evidence, that the tornado is identical with the convective discharge of electricity.

*On the State of Atmospheric Strata holding Accumulations of Electricity as in Thunder Storms.*—In order to sustain the inferences which I have advanced, it is sufficient, as already avowed, to point out that no difficulty can be ascribed to the existence of an electrical accumulation competent to produce a convective discharge in the form of a tornado, which does not apply equally against any accumulation of the same nature, capable of producing diruptive discharges, as in the case of lightning. The precise mode in which a thunder cloud becomes a reservoir of electricity, and afterwards emits it as lightning, was not suggested by Franklin, and is still undecided. That this precision of explanation has not been attained in the case of the tornado, cannot then be fairly or consistently avowed as an objection to our considering this meteor as the offspring of the same parent.

If we strive to electrify a ball suspended to a steelyard or scale beam, as in Cuthbertson's electrometer, so as to be equiponderant with a counterweight on the other arm of the beam, it will descend as soon as charging commences. Wherefore, then, do not thunder clouds descend in obedience to an incipient charge? I believe this question has never been answered.

I would suggest that, agreeably to Faraday's researches, we are justified in supposing that as the charge consists more or less of the polarization of the aerial particles, by which they assume a certain arrangement

indispensable to an electrical charge, and which grows with its growth, and strengthens with its strength.

Thus there may be a simultaneous and commensurate affection, by which the opposite polarities, usually called the opposite electricities, created at the surfaces of the electrified (or, as I would say, polarized) stratum of the atmosphere, are produced together with that arrangement of the aerial atoms in rows, like iron filings situated between poles of a magnet. Hence the same electrifying causes which induce in the extreme surfaces a reciprocal attraction, cause in the intermediate atoms a proportional indisposition to undergo the derangement which any obedience to that attraction would involve.*

*Objections to Espy's Hypothesis.*—It is well known that, when suddenly rarefied, air is refrigerated; hence, when a receiver is first subjected to exhaustion, a cloud appears within it, arising from the condensation of aqueous vapor. Dalton found that when the air thus rarefied was devoid of aqueous vapor, it became much colder than when this vapor was present.

* If when there is a great accumulation of electricity, sufficient for the emission of lightning, we suppose the atmospheric stratum which holds the charge to perform the part of the glass in a charged pane, the cloud and the earth acting as coatings, the following rationale may be countenanced by the facts.

This rationale assumes that electricity consists of opposite polarities, resulting, as Faraday supposes, from an "*action*" of atoms in proximity, or as I infer, from a polar *affection* resulting from the polarization of etherial matter associated or combined with ponderable matter. The same reasoning would apply were the hypothesis of two fluids assumed, in which the phenomena are ascribed no less to repulsion than to attraction.

Let us suppose a stratum of the atmosphere to be situated just above the height of three miles, and of course to have only half the mean density of a stratum resting on the terrestrial surface. Let it be supposed that these strata are oppositely electrified, as in the case of thunder storms. Of course, the oppositely excited strata will have a tendency to approach each other, while the terrestrial surface, similarly electrified with the lower stratum, will repel this, simultaneously attracting the upper stratum. But will the attraction of the earth for the sparse and remote air of the upper stratum balance the repulsion exercised by it towards the contiguous and denser stratum below? Will not the force in the latter instance be greater, first, because, in the same space, there are twice as many atoms to repel, and in the next place, because they are in proximity to the earth? See *Silliman's Journal*, Vol. v., n. s., p. 345.

Again, while the similarly electrified aerial particles in either stratum must repel each other in consequence of their similar excitement, will not this effect in the lower stratum be twice as great, (if not quadruple,) in consequence of there being twice as many atoms in the same space? Thus while gravitation is counteracted by electrical repulsion, the gaseous elasticity of the air is increased by the same cause. Hence arises an expansive and ascensional power. Although the whole of the atmospheric stratum similarly electrified by the terrestrial surface must be repelled thereby, yet the force being equally distributed, is insufficient to cause the whole to be elevated so as to create a vacuum. It is under these circumstances that either the diruptive discharge may take place in the form of lightning, in which case an intermediate row of aerial particles become instrumental to the meeting of two opposite waves of electro-polarity; or a convective discharge may take place by a concentration of the forces on a comparatively minute columnar space. Within this space all the forces are exaggerated which have been assigned to the aggregate. Hence, while the aerial elasticity is assisted by a reciprocal electro-polar repulsion, the whole mass of the air and bodies within the space are violently repelled by the earth. Hence the expansive power by which houses are burst, and bodies, sufficiently light and movable, are borne aloft accompanied by an electrified aerial blast.

An exemplification of this concentration of force is to be seen in the perforation of the glass of a charged jar.

Were the mean height of the upper stratum only 1½ miles, the difference of density would be only one-fourth of that assumed, but still evidently there would be a diversity more than sufficient to account for the expansive and ascensional power.

This he ascribed to the latent heat given out by aqueous vapor on condensing. Before I had the pleasure of knowing Mr. Espy, I contrived an apparatus for showing the cold and cloud produced by rarefaction. *Silliman's Journal, Vol.* 13, *p.* 4.

This apparatus, as well as that employed by Dalton, does not differ essentially from Espy's nephelescope, which is the name given by him to an instrument answering the same purpose as that employed by Dalton. Notoriously, the density of the air diminishes, in a geometrical ratio, as the place of examination is higher; so that at the altitude of three miles it is only half as dense as upon the earth's surface.

Davy, in his elements, ascribed the formation of clouds to the refrigeration arising from the rarefaction of ascending columns of air, and to this I used to advert in my lectures, nearly thirty years ago, using the nephelescope, which I had contrived, as above mentioned, to illustrate the idea.

Thus it became evident, from the experiments and suggestions of Dalton and Davy, that when the different portions of air, in an upward current, successively reach a height sufficient to rarefy and cool them to a certain extent, the aqueous vapor which they hold must form a cloud, and at the same time render them lighter and warmer than the surrounding air.

It was first assumed by Espy that the rise of temperature thus caused, would create a buoyancy like that of a balloon, and an upward force, and so great an acceleration as to produce the phenomena of a tornado at the foot of the column affected. In fact, the buoyancy thus arising is, by this ingenious author, considered as universally the cause of storms.

Admitting his estimate of the buoyancy consequent to the condensation of vapor to be correct, I aver that no buoyancy thus created in the upper part of an aerial column, would cause any disturbance of the column below the level of that upper part.

Count Rumford first showed that water may be boiled at the top of a containing vessel without warming the liquid lying below the part where the heat may be applied. This fact has been demonstrated by me on a large scale during each of thirty courses of lectures. *In Mr. Espy's presence*, about five years ago, I demonstrated that this law is equally true in the case of air.

A large bell-glass was so supported in an inverted position, as to allow the axis of a spirit lamp flame to be concentric with the bore of the neck. In the next place, a tuft of cotton, nearly equalling in diameter the mouth of the bell, was moistened with alcohol. By means of tongs, this tuft, being held just above the mouth of the bell, was inflamed. Of course, the difference of temperature thus created was incomparably greater than any which could be producible by the latent heat yielded by condensing vapor. Moreover, the whole lifting influence was concentrated upon the comparatively narrow area of the bore in the neck; yet the smallest acceleration could not be perceived to take place. The flame was not in the slightest degree disturbed. Subsequently, at the meeting of the association at Cambridge, in 1849, an apparatus was constructed by which the experiment above described, was repeated with an improved arrangement.

Inside of the inverted bell, so as to cover the bore of the neck imme-

diately over which it rested, a disk of wire gauze was placed, supporting a few thin fibres of carded cotton. About half an inch above the mouth of the bell another disk or tray of wire gauze was upheld by appropriate means, on which there was put a stratum of carded cotton sufficiently copious. These preparations being completed, the cotton above the bell was ignited. Notwithstanding the enormous rise of temperature thus produced in the upper part of the column of air, of which the lower portion occupied the bell glass, so entirely was this lower portion uninfluenced that there was not the least perceptible agitation produced among the most delicate fibres of the cotton.

This perfect immobility of the air subjacent to a column of that fluid, to which a great ascensional power seems to be imparted by the ignition of the cotton, as above described, will not exite wonder, when it is recollected that the buoyancy is not the consequence of absolute levity, but of comparatively lesser weight. The ascent of a balloon is not spontaneous; it is the effect of coercion. It is forced to ascend by the superior gravity and consequent pressure of the surrounding air. But while this displaces the balloon, it does not, on that account, relax its pressure on the subjacent portion of the atmosphere.

It is admitted, that, on reaching the rarefied region where the atmospheric clouds appear, the consequent condensation of aqueous vapor will make any body of air containing it warmer than it would otherwise be, and from the lowest level above which the heat is applied there would be a more or less disturbance, in consequence of the greater buoyancy of the column warmed by the condensation of vapor. But this disturbance would, as I conceive, be much less abrupt and forcible than the Espyan hypothesis of storms requires.

Even after the condensation of aqueous vapor is effected, the water which formed it will remain within the column, and still add to its weight, so that the total weight will not be diminished. Moreover, by swelling upwards, as it naturally will do, towards the region where there is least resistance, it will become as much taller as rarer, and thus compensate by its greater height for the loss of specific gravity. In a non-elastic fluid, any superiority of elevation, in any portion expanded more than the rest, would be rapidly compensated by the overflow of the excess; but in an elastic fluid, where the summit must be so rare as to have scarcely any perceptible weight, no such active overflow can take place as would be requisite to produce any violent exchange of position between the column thus affected and the surrounding portion of the atmosphere.

If, as represented by Espy, all that is requisite to produce a tornado is an upward current of air, pre-eminently warm and moist, and penetrating into the region of the clouds, the conditions are abundantly realized in the vicinity of the equator. The trade winds have long been ascribed to the ascent of air from the regions on each side of the equatorial line, in consequence of the rarefaction arising from a comparatively superior temperature.

To supply the vertical current thus created, the air is conceived to flow towards the equator from regions more remote, and less heated by the sun; the currents thus caused being rendered more westerly in their direction, relatively to the earth's surface, by the diurnal motion of that

surface, which is necessarily accelerated with the increase of its distance from the terrestrial axis, as the equator is approached. As, in consequence of the warmth to which its ascent is attributed, and an ample contact with the surface, the upward current must be replete with aqueous vapor, all the requisites which the Espyan theory requires for the production of a perpetual gigantic tornado are present; and yet none is produced.

With the hypothesis which ascribes tornados to an electrical discharge, it is quite consistent that there should be no thunder storms within the region of the vertical current, or the trade winds produced thereby, since there is a perpetual discharge by convection, preventing of course any electrical accumulations.

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## *On Certain Points in the Construction of Marine Boilers.* By J. Scott Russell, M. Inst. C. E.*

The author having arrived at certain theoretical results relative to the construction of marine boilers, put them into practice about ten years back, in designing the boilers for the Royal Mail Steam Packets *Clyde*, *Tay*, *Tweed*, and *Teviot;* and as they had been in constant work ever since, running from 42,000 miles to 48,000 miles per annum, without material repairs, he believed their durability, combined with effective combustion and economy of fuel, had been fully established. The principles upon which these boilers were constructed differed from those generally recognised. In the first place, it was considered that a judicious distribution of the most intensely heated surfaces would be conducive to durability; and for this purpose, instead of returning the flues over the furnaces, the top of the furnaces and the hottest flues were brought to the surface of the water, and the cooler or return flues were taken to the bottom of the water. The water was admitted at the bottom, and was gradually warmed as it rose, the greatest heat being imparted at the last moment, by which means the bubbles of steam were prevented from accumulating in contact with intensely heated metal. In the next place, the capacity of the furnaces or fire-boxes was unusually large, and their height above the incandescent fuel much greater than usual. The evaporating surface in these boilers was also much more than customary, there being no less than three feet of evaporating surface for every foot of furnace bars. The process of blowing off was provided for by arranging under the flues and furnaces large water spaces, as reservoirs for the collection and blowing off of brine and other deposit.—*Proceed. Inst. Civ. Eng.*, *March* 23.

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## *A Description of a Diaphragm Steam Generator.* By M. Boutigny (d'Evreux).†

The principle upon which this steam generator was based, was that "bodies evaporate only from their surfaces." This being received as an axiom, it must necessarily follow that in the construction of steam boilers,

* From the London Civil Engineer and Architect's Journal, April, 1852. † Ibid.

either the evaporating surface of metal should be extended to its utmost limit, or the water should be so divided, and its evaporating surfaces be so multiplied, as to arrive at the same end, of obtaining the greatest amount of steam by the expenditure of the least amount of fuel. The steam generator was described to consist of a vertical cylinder of wrought iron, 25 inches high by 12⅝ inches diameter; the base terminating in a hemispherical end, and the upper part closed by a curved lid, upon which was attached the usual steam and safety valves, feed, steam, and other pipes, &c. The interior contained a series of diaphragms of wrought iron, pierced with a number of fine holes, and having alternately convex and concave surfaces. They were suspended by three iron rods, at given distances apart, in such a manner as not to be in contact with the heated exterior, or shell of the boiler. When any water was admitted through the feed-pipe, it fell upon the upper (convex) disk, which had a tendency to spread it to the periphery, the largest quantity falling through the perforations in the shape of globules; the second diaphragm being concave, tended to direct the fluid from the circumference to the centre, and so on, until, if any fluid reached the bottom of the cylinder, it mingled with a thin film of water, in a high state of ebullition, that being the hottest part of the boiler. It appeared, however, that in its transit through these diaphragms, the water was so divided, that exposing a very large surface to the caloric, it was transformed into steam with great rapidity, and with great economy of fuel. The boiler described had been worked for a long time at Paris with great success, giving motion to a steam engine of two horse power. The consumption of coal was stated to be very small, 789 pounds of water having been converted into steam by 182 pounds of coal in nine hours, under a pressure of ten atmospheres. The chemical part of the question was carefully examined, and it was shown, that at that temperature the iron was exactly in the best condition to bear strain. The practical application on a large scale was submitted to the engineers, the author having only proposed the system for small boilers, and under circumstances of wanting to obtain a motive power in situations of restricted space, and where first cost was a great object.—*Proceed. Inst. Civ. Eng.*, *March* 23.

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For the Journal of the Franklin Institute.

## *On the Telegraphic Lines of the World.* *By* Dr. L. Turnbull.

### United States.

In giving an account of the number of telegraphic lines, it will be proper to place the United States as first on the list, from the number and extent of the lines, and from the extensive use made of them in every department, both for business and pleasure. Still, it will be but an approximation to the number, for they are like the spider's web, forming a complete network over the length and breadth of the land, from the extreme north-eastern point to the western boundary of Missouri, adjoining the Indian territory. A continuous line of telegraph now extends from the verge of civilization on the western frontier (east

of the Rocky Mountains) to the north-eastern extremity of the United States; and the time is not far distant when we shall have a telegraph from the Mississippi river to San Francisco. This is no fancy sketch, as the route is already selected for the California line, and a most interesting Report was presented to the Senate of the United States in the session of 1851, by the Committee on Post Offices and Post Roads.

"The route selected by the Committee is, according to the survey of Captain W. W. Chapman, U. S. Army, one of the best that could be adopted, possessing as it does great local advantages. It will commence at the City of Natchez, in the State of Mississippi, running through a well settled portion of Northern Texas, to the town of El Paso, on the Rio Grande, in latitude 32°; thence to the junction of the Gila and Colorado rivers, crossing at the head of the Gulf of California, to San Diego, on the Pacific; thence along the Coast to Monterey and San Francisco. By this route, the whole line between the Mississippi River and Pacific Ocean will be south of latitude 33°; consequently, almost entirely free from the great difficulties to be encountered, owing to the snow and ice on the Northern route, by the way of the South Pass, crossing the Sierra Nevada Mountains in latitude 39°. The whole distance from the Mississippi to San Francisco will be about 2400 miles."

The great benefits to be derived, the Report fully and ably sets forth, whether in a military, commercial, or social point of view.

"In a commercial point of view, the line in question assumes a gigantic importance, and presents itself not only in the attitude of a means of communication between the opposite extremes of a single country, however great, but as a channel for imparting knowledge between distant parts of the earth. With the existing facilities, it requires months to convey information from the sunny climes of the East to the less favored, in point of climate, but not less important regions of the West, teeming as they do, with the products of art and enterprise. Let this line of wires be established, and the Pacific and Atlantic Oceans become as one, and intelligence will be conveyed from London to India in a shorter time than was required ten years since to transmit a letter from New York to Liverpool."

"Nor does the importance of the undertaking claim less interest, when regarded in a social point of view. California is being peopled daily and hourly by our friends, our kindred, and our political brethren. The little bands that a few centuries since landed on the Western shores of the Atlantic, have now become a mighty nation. The tide of population has been rolling onward, increasing as it approached the setting sun, until at length our people look abroad upon the Pacific, and have their homes almost within sight of the spice groves of Japan. Although separated from us by thousands of miles of distance, they will be again restored to us in feeling, and still present to our affections, through the help of this noiseless tenant of the wilderness."

In the Congressional *Globe* of April 6, 1852, Mr. Douglass presented the memorial of Henry O'Reilly, proposing a system of intercommunication by mail and telegraph, between the Atlantic and Pacific States. All he asks is permission to establish a telegraphic line from the Mississippi Valley, where the wires now terminate, to the Pacific Ocean, and to be

protected by a line of military posts, so that he can keep up the communication for the benefit both of the Government and of the public. Mr. O'Reilly states in this memorial, that within two years from this time, with this line completed, he would be able to deliver the European news on the shores of the Pacific within one week from the time it left the European Continent. The motion was referred to the Committee on Territories.

These are but a part of the advantages set forth in the bill, with a strong recommendation from the Committee for its passage.

The authorities of Newfoundland have granted to Mr. H. B. Tibbatts and associates, of New York, the exclusive right to construct and use the magnetic telegraph across that island, for the period of thirty years. The grant is designed to facilitate Mr. Tibbatts in his scheme for the establishment of steam and telegraphic communication between New York and Liverpool or London, *in five days*. The telegraph is to extend from New York to St. Johns, from whence a line of steamers is to run to Galway, where another line of telegraph is to commence, extending to London. This latter line will, it is said, be completed during the current year. The distance from St. Johns to Galway is 1647 miles, or about five days' sail.

There are numerous lines in actual and successful operation under the title of Morse, House, and Bain, each giving every facility to the business man.

A recent letter from Charles T. Chester, Esq., Telegraphic Engineer, who is connected with the Morse Line, the first and most extensive one in the United States, gives the following statistics of the facilities for the transmission of intelligence along their lines in the chief cities of this country.

"Two Morse wires run to Boston, three to Buffalo, five to Philadelphia, four to Washington, and two on to New Orleans; on the Western and Canada routes there is generally but one."

The above list will give an approximation of the number of the Morse lines, obtained principally from Mr. Chester, and from the work of Disturnell, published January, 1852. The following is a list of the names of the Companies:

1. Washington and New Orleans Telegraph, organized under Morse's patent; tariff of charges, \$2; from Washington to New Orleans, 1716 miles, with 19 stations; no charge for address, signature, or date; Daniel Griffin, Esq., President.

2. Atlantic and Ohio Telegraph Line; Philadelphia office, 101 Chesnut street; tariff of charges, \$1·30 to Milwaukie, Wis.; from Philadelphia to Milwaukie, 812 miles, with 76 stations.

3. The Magnetic Telegraph Company Line, extending from New York to Washington City; office, No. 5, Hanover street, corner of Beaver street, New York; rates of charges, 50 cents; from New York to Washington, 245 miles, with 10 stations. Also, from New York to New Orleans, \$2·50; but when a communication exceeds 100 words, the price on all words exceeding that number will be reduced one-third.

4. New York, Albany, and Buffalo Telegraph; office, No. 16, Wall street, New York, up stairs; from New York to Niagara, 500 miles; 65 cents. This line connects with numerous towns and cities in Vermont, Canada, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Wisconsin, Iowa, Tennessee, and Kentucky; with 76 stations.

5. Troy and Canada Telegraph; from Troy to Montreal, with 14 stations.
6. Magnetic Telegraph Line, from Boston to Halifax, N. S., with 12 stations.
7. New York and Boston Magnetic Telegraph Association, organized under Morse's patent; office, No. 5, Hanover street, near Beaver street, New York; from Boston, Mass., to Halifax, N. S.; with 35 stations. Also, from New York, via Bridgeport, to Birmingham, Conn.; with 11 stations; 50 cents for 10 words.

The first American telegraphic line was established in May, 1844, between Washington and Baltimore, over a length of 40 miles.

The line from Washington to Baltimore also proceeds to Philadelphia and New York, over an extent of 250 miles. It reached Boston in 1845, and became the great line of the North, from which branched two others: one, the length of 1000 miles, from Philadelphia to Harrisburg, Lancaster, Pittsburg, Ohio, Columbus, Cincinnati, Louisville (Kentucky), and St. Louis (Missouri); the other, the length of 1300 miles, from New York to Albany, Troy, Utica, Rochester, Buffalo, Erie, Cleveland (Ohio), Chicago (Illinois), and Milwaukie (Wisconsin).

A fourth line goes from Buffalo to Lockport, Queenstown, the Lakes Ontario and Erie, the Cataracts of Niagara, Toronto, Kingston, Montreal, Quebec, Halifax, and the Atlantic Ocean, over an extent of 1395 miles.

Two lines South; one from Columbus to New Orleans, by Cincinnati; the other from Washington to New Orleans, by Fredericksburg, Charleston, Savannah, and Mobile. The first is 1200 miles long, the second 1122 miles. This line has been extended West to Independence, Missouri.

In April, 1852, direct communication was had between the New Orleans Telegraph office and the office of the New Orleans line in Hanover street, New York, the whole extent of near 3000 miles of wire having been successfully worked in a single circuit. Despatches were sent from New York to New Orleans sixty minutes ahead of time.

The House Printing Telegraph has only been in operation since 1846, but even in that short time has spread itself over a large portion of the United States, working to the entire satisfaction of our business community, and wherever found, exciting the admiration of the curious, being able to print in Roman capitals communications in almost every language.

This line consists of the Boston and New York Telegraph Company, using the House Printing Telegraph; about 600 miles of wire, two wires; stations at Boston, Mass.; Providence, R. I.; Springfield, Mass.; Hartford, Conn.; New Haven, and New York.

A line is being constructed to connect with this Boston line, running from Springfield, Mass., to Albany, N. Y.; there to intersect the New York and Buffalo line, using the same instruments, extending from New York to Buffalo, a distance of 570 miles. One wire is now in operation, connecting with Poughkeepsie, Troy, Albany, Utica, Syracuse, Lyons, Rochester, Albion, Lockport, and Buffalo; and another wire, nearly completed the same distance. This line is to continue to St. Louis, Mo., connecting with Cleveland, Cincinnati, Louisville, and St. Louis, which will be completed the entire distance in 1852; forming the longest line in the

world under the direction of one company, the whole length being 1500 miles.

The New Jersey Magnetic Telegraph Company, using the House instruments, and the first line of this kind ever put in operation, extends from Philadelphia to New York; one wire, 132 miles; and another now being put up. For this information, I am indebted to the politeness of William J. Philips, Esq., Telegraphic Engineer on the House line at Philadelphia.

Making the whole number of miles 2802; rate, 25 cents for the first ten words from Philadelphia to New York.

The Atlantic and Pacific Telegraph range, under the arrangement of Henry O'Reilly, Esq., using a modification of Bain's Chemical Telegraph and Morse's instrument, from New York to Washington, and from New York to Boston. Also, the first division, constructed eastward of the Mississippi, known as the "Atlantic, Lake, and Mississippi Telegraph," extending to the Atlantic, and connecting nearly all principal cities and towns between the Canadian frontier and the Mexican Gulf—embracing the Ohio and Mississippi vallies, as well as the Lake country; about 6000 miles constructed, and 3000 miles contracted for construction.

The second division, westward of the Mississippi, to include the "Mississippi and Pacific Telegraph," of which about 500 miles of river distance, embracing the principal towns along the Missouri, between St. Louis and Fort Leavenworth, is contracted for construction, additional to other extensions in different quarters, west of the Mississippi, to be extended from Fort Leavenworth to San Francisco, when Congress authorizes the extension through the public domain.

The Bain Line, now a Morse Line, Mr. Henry J. Rodgers, General Superintendant from New York to Washington, has lately constructed, at an expense of $10,000, spars 310 feet high, at the Palisades and Fort Washington, ten miles above the City of New York, for the purpose of sustaining their wires over the river, instead of the method formerly employed, by passing the current through the water, by wires laid across the North River. He considers this method, by means of suspension on spars, as being more permanent and durable. The price of telegraphic despatches by this line is the same as the others. They have offices in Boston, Providence, New York, Philadelphia, Wilmington, Baltimore, and Washington.

The Bain Lines in the United States are as follows:

One from Louisville to Memphis, called an O'Reilly Line, and contemplate using the same instrument to New Orleans on the same line.

One from New York to Boston; 2 wires.

One from Boston to Portland, Me.

And one from New York to Buffalo; 2 wires.

The profits to the stockholders amount to from three to six per cent. per annum. The usual expense of constructing these lines varies from $100 to $200 per mile.

*List of the Morse Telegraph Lines in the United States.*

| | | MILES. |
|---|---|---|
| 1. | Washington to New Orleans, by way of Richmond, Va., | 1,716 |
| 2. | Washington to New York, by way of Baltimore and Philadelphia, 5 lines, each 250 miles, | 1,250 |
| 3. | Harper's Ferry to Winchester, Va., | 32 |
| 4. | Baltimore, by way of Pittsburg and Wheeling, to Cumberland, | 324 |
| 5. | Baltimore to Harrisburg, by way of York, Pa., | 72 |
| 6. | York to Lancaster, by way of Columbia, Pa., | 22 |
| 7. | Philadelphia to Lewistown, Del., | 12 |
| 8. | Philadelphia to New York, 6 lines, each 120 miles, | 720 |
| 9. | Philadelphia to Pittsburg, by way of Harrisburg, | 309 |
| 10. | Philadelphia to Pottsville, by way of Reading, | 98 |
| 11. | Reading to Harrisburg, | 51 |
| 12. | New York to Boston, by way of New Haven, &c., 2 lines, each 240 miles, | 480 |
| 13. | New York to Buffalo, by way of Troy and Albany, 5 lines, each 500 miles, | 2,500 |
| 14. | New York to Fredonia, N. Y., by way of Lake Erie, Newburg, and Oswego, | 450 |
| 15. | Bridgeport, Conn., to Bennington, Vt., by way of Pittsfield, | 150 |
| 16. | Boston to Newburyport, by way of Salem, Mass., | 34 |
| 17. | Boston to Portland, by way of Dover, | 110 |
| 18. | Worcester to New Bedford, by way of Providence, | 97 |
| 19. | Worcester to New London, by way of Norwich, | 74 |
| 20. | Portland to Calais, Me., | 260 |
| 21. | Calais to St. Johns, N. B., | 75 |
| 22. | Troy to Whitehall, by way of Salem, | 72 |
| 23. | Troy to Montreal, Canada, by way of Rutland and Burlington, | 278 |
| 24. | Syracuse to Oswego, N. Y., | 38 |
| 25. | Auburn to Elmira, by way of Ithaca, N. Y., | 75 |
| 26. | Binghampton to Ithaca, by way of Oswego, N. Y., | 48 |
| 27. | Buffalo to Queenston, Canada, by way of Lockport, | 48 |
| 28. | Buffalo to Milwaukie, Wis., by way of Lake Erie and Chicago, Ill., | 812 |
| 29. | Queenston to Montreal, by way of Toronto and Kingston, | 466 |
| 30. | Montreal to Quebec, | 180 |
| 31. | Cleveland to Pittsburg, by way of Alton, Ill., | 150 |
| 32. | Pittsburg to Cincinnati, O., by way of Columbus, | 310 |
| 33. | Pittsburg to Columbus, | 680 |
| 34. | Columbia to Memphis, Tenn., by way of Wheeling, | 205 |
| 35. | Columbia to New Orleans, by way of Tuscumbia and Natchez, | 638 |
| 36. | New Orleans to Balize, at the mouth of the Mississippi, | 90 |
| 37. | Columbia to Chilicothe, Ohio, | 45 |
| 38. | Cincinnati, Ohio, to Maysville, Ky., by way of Ripley, | 60 |
| 39. | Cincinnati to St. Louis, Mo., by way of Vincennes, | 410 |
| 40. | St. Louis to Chicago, by way of Alton, Ill., | 330 |
| 41. | Alton to Galena, by way of Quincy, | 380 |
| 42. | Quebec to Halifax, | 700 |
| 43. | St Louis to Independence, Mo., | 25 |
| 44. | New York to New Orleans, | 3,000 |
| | Total, | 17,283 |

Making in all the lines—

| | | |
|---|---|---|
| House Line, | 2,802 | miles. |
| O'Reilly Line, using in most of the offices the modified Bain instrument—part of the O'Reilly Lines using the Morse instrument, | 6,000 | " |
| Morse Line, | 17,283 | " |
| Bain Line, | 1,092 | " |
| Total number of miles in the United States, | 27,177 | |

(To be Continued.)

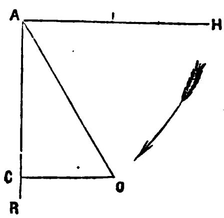
For the Journal of the Franklin Institute.

## *On Oblique Action.* By T. W. Bakewell, Esq.

In the following remarks, "loss of power" means inefficient consumption of steam; in other words, power and steam are used synonymously.

A *gain* of power by any obliquity of forces (or vision,) has ceased to be orthodox; but a *loss* therefrom still lingers as canonical.

A loss of power is ascribed to oblique action on the water in some positions of the arm of side wheel steamers; and truly, there is a small loss by oblique over direct action on the water which will be noticed below; but that is not the loss in question.




Let A R be the vertical arm of the wheel, pressed by the force from the engine, against an unyielding object at R; the advance of the vessel would be the measure of the power or steam used.

Let A H be the horizontal arm, opposed at H by an unyielding object; then, as there is no advance of the vessel, no power is used, and no mechanical effect produced.

Hence, it is evident, that at any position between the vertical and horizontal, the arm being in like manner opposed by an unyielding object; the expenditure of steam would be restricted to that part of the force tending to propel the vessel, and the other portion tending to raise the vessel would be reserved.

The reservation of steam, implies a *pro tanto* loss of time, and although not the point under discussion, may bear a remark. The course of action with a crank and connecting rod, shortening the leverage as the dead point is approached, is precisely similar to the mode of decrease of propelling power as the arm of the wheel approaches its dead point at A H.

This apparent loss of time by the retention of steam, is with the wheel as with the crank, obviated simply by the steam "getting stronger."

An oblique arm cannot annihilate or dispose of the power given out to it by the engine, except by advance of the vessel, or slip of the paddle; otherwise, we might anchor a vessel in the current, and make the wheel the motor to the cylinder converted into a double acting force pump; when that position of the former power from the cylinder which was nullified by obliquity, would become a gain to the wheel of equal amount.

The loss in practice which occurs from oblique action, arises from the loss by slip of the paddle through the water becoming *proportionably* greater, as the propelling part of the force decreases by obliquity.

The loss from this source is dependent on size of wheel and paddle, force applied, &c., and the following merely exhibits the governing principle:

The propelling effect is as the cosine directly, and the loss by slip, as the cosine inversely, where A R, radius $=1$; then to the vertical arm A R, with a propelling effect$=1$, there is a loss by slip of say 20 per cent. to the oblique arm A O, (at 30°); with a propelling effect as cosine A C $= \cdot 866$, there would be a proportional loss of 23 per cent. In actual

practice, however, the above increase of 3 per cent. loss, seemingly due to the oblique arm, is much reduced by partial immersion, and by the reciprocally neutralizing motions of the wheel backwards, and the vessel forwards, causing the paddle to enter the water nearly edgewise, and to be withdrawn in the same manner after passing the vertical.

A frequent contributor to the Journal on this subject, in giving details of marine engines and their effects, generally places the loss by oblique action in side wheel steamers (exclusive of slip,) at 12 to 17 per cent., but in similar details with screw propellers where the action is entirely oblique, this item is omitted.

*Cincinnati, June,* 1852.

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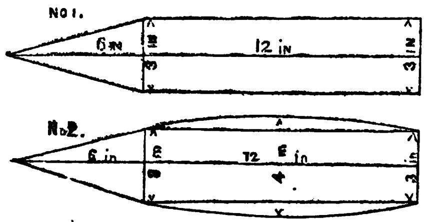
*Hints on the Principles which should regulate the Forms of Boats and Ships, derived from original Experiments.* *By* MR. WILLIAM BLAND, *of Sittingbourne, Kent.**

Continued from vol. XXIII, page 358.

CHAPTER VII.—EXPERIMENTS RELATING TO THE MIDDLE.

The segment of a circle, which subtends $\frac{1}{4}$-inch in the centre of a base line of 6 inches, having proved beneficial towards the promotion of speed when applied at the bows, as given in Experiment 10, and at the stern in Experiment 24, induced a further trial of the same curve in the experiments annexed:




Scale, $\frac{1}{8}$-inch to 1 inch.

*Experiment* 28.—The two models (Nos. 1 and 2) of the same bows, length, and weight, but differing in their sides, one being parallel, the other convexed; the rise at mid-length being $\frac{1}{2}$-inch to the whole length of side of 12 inches, according to the proportions before adopted.

Upon being tried against each other at the ends of the balance-rod, it appeared that the speeds were equal. This makes a third instance of the good qualities of the curve in the promotion of speed over the straight line.

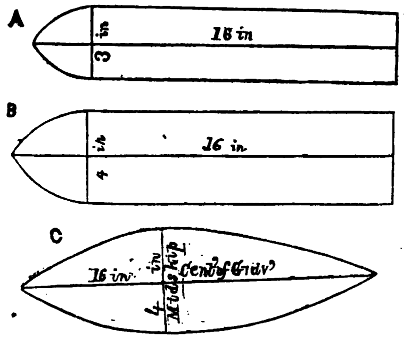
In this experiment is seen greater breadth of beam, equal indeed to one-fourth; yet, by the adoption of the curve in question, equal speed is obtained.

*Experiment* 29.—Segments of circles of different diameters were further applied and tested against two parallel-sided models; one of the same

* From the London Architect for September, 1851.

breadth of beam, the other of less beam by one-fourth part; all three, however, of the same weight, 23 oz.

Scale, ⅛-inch to 1 inch; thickness, 2 inches.



Modelled from the horizontal section of the sole fish.

The first trial took place between the models A and C. The result gave the speed of C to be greater than A, in the proportion of 5 : 4; or taken in weight, equal to 8 oz.; because the model C required to be loaded with that weight extra, to retard its speed to an equality with the speed of A.

*Experiment* 30.—The second trial was between the models A and B. In this instance, the speed of A beat that of B, by the extra weight of 4 oz.

*Experiment* 31.—In the third trial, the speed of the model C beat that of the model B, by 12 oz. extra weight.

*Experiment* 32.—The model C was drawn through the water, having its stern or sharper end foremost, and in consequence of so doing, the speed was reduced. Moreover, by the sharper end going foremost, the steadiness of its course was in a great measure destroyed, the model requiring a piece of keel to be attached at the aft end to cause the body to preserve a straight course; and which was not found necessary when the bluffer end or bows met the water when floating upon an even keel.

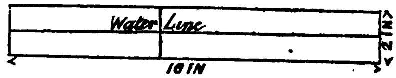
The inference to be drawn from the last four experiments is in every respect in favor of the bird or duck shaped model C; at the same time pointing out the wisdom of preferring the bluffer or larger end to go foremost, rather than the sharper end.

## Chapter VIII.

The subjoined experiments were undertaken to ascertain the effects of cutting inclined up of vessels from the midship section, both to the head and stern. To this end, three models were made of the precise form and size of C in the preceding chapter, with the exception of their being varied from it as delineated below, scale ⅛-inch to 1 inch.

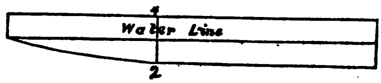
The inclination upwards, or curves at both the bows and stern of these diagrams, are sections of two circles, having their centres in the same straight line (numbered 2, 4,) at the midship sections of the diagrams, when produced indefinitely in the direction of 2, 4; and their circumferences passing through the points 1 and 2, 2 and 3.

*Experiment* 33.—The models C and D being first made of equal weight, were tested as to their speed; and it was found that the model D with its bows cut inclined up, beat C with the level bottom by 8 oz. additional weight.



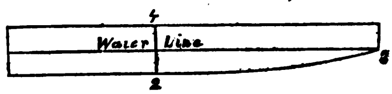

Side view of model C.—Weight 22 oz.

D



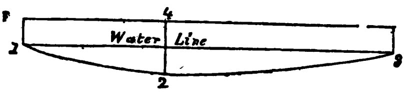

The model with the bows from 1 to 2, cut inclined up.

E




The model with the stern from 2 to 3, cut inclined up.

F




The model with both the bows and stern cut inclined up.

*Experiment* 34.—Next, the model C was tested with E, having its stern cut inclined up; when C was again beaten in its speed, the model E carrying with equal speed 6 oz. extra weight.

*Experiment* 35.—After this, the two models D and E were tried against each other, and the advantage in speed was, in weight, 2 oz. on the side of the model D.

*Experiment* 36.—Lastly, the models C and F were put upon the water together, the latter having both its bows and stern cut inclined up. The difference in their speed was altogether in favor of F; indeed, equal to 12 oz. or more, for this extra weight was not sufficient when put into F, to equalize the speed of the two models, but the great weight F already carried was quite load enough, without sinking too deep into the water.

The conclusion to be drawn here is, the positive good effects from the cutting or curving up of both the head and stern of vessels, when commenced from the midship section, and extending as far at least, each way, as the load water-line.

(To be Continued.)

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For the Journal of the Franklin Institute.

## *Notes on the U. S. Surveying Steamer Walker.* By B. F. Isherwood, Chief Engineer, U. S. Navy.—(*With a Plate.*)

The *Walker* was one of the batch of eight iron revenue steamers, commenced in 1843, for the Treasury Department. She was built at Pittsburg, Pennsylvania, by J. Tomlinson, and was one of the two originally fitted with paddle wheels. The experiment tried by the Treasury, of substituting steam for sailing cutters, having signally failed from the too large size of the steamers, the expense of maintaining them, and the

abortive character of their machinery and propelling instruments, they were either turned over to the Coast Survey, or otherwise disposed of. Of the eight, only three now remain in the Government service, viz: the *Legaré*, the *Bibb*, and the *Walker*, and they are employed as Surveying Steamers.

During the present year, the *Walker* has been refitted with new boilers at the works of Messrs. Merrick & Son, Philadelphia. The dimensions of the vessel, machinery, &c., are now as follows:

HULL.

| | |
|---|---|
| Length between perpendiculars, | 132 feet. |
| Beam extreme, | 24 " 6 inches. |
| Depth of hold, | 11 " 3 |
| Mean draft of water for all the steaming done, | 9 " 8 |
| Burthen, | 305 tons. |
| Immersed amidship section at 9¾ feet draft, | 193 square feet. |
| Square feet of immersed amidship section, per cubic foot of space displacement of pistons, | 2·708 to 1·000 |
| Square feet of immersed amidship section, per cubic foot of space displacement of pistons, multiplied by number (22) of double strokes of piston per minute, | 0·123 to 1·000 |

ENGINES.

Two horizontal, half beam, condensing engines, Lighthall's patent.

| | |
|---|---|
| Diameter of steam cylinders, | 2 feet 9 inches. |
| Stroke of steam piston, | 6 " |
| Diameter of air pumps, | 2 " 8 " |
| Stroke of air pump piston, | 1 " 4 " |
| Space displacement of steam pistons per stroke, | 71·274 cubic feet. |
| Space displacement of air pump pistons per stroke, | 14·893 " " |
| Mean effective pressure by indicator on piston per square inch, (steam pressure in boiler 11·3 pounds, cutting off at half stroke, throttle one-third open, being average of all steaming done,) | 13½ pounds. |
| Double strokes of piston under above conditions per minute, | 22 |
| Horses power developed by engines under above conditions, | 181·26 |

PADDLE WHEELS.

| | |
|---|---|
| Diameter from outside to outside of paddles, | 16 feet. |
| Length of paddle, | 6 " |
| Breadth of paddle, | 2 " |
| Immersion of lower edge of paddle at 9¾ feet draft of vessel, | 4 " |
| Area of two paddles, | 24 " |
| Number of paddles in each wheel, | 12 " |
| Number of paddles in each wheel in water at 9¾ feet draft of vessel, | 3 " |
| Proportion of the area of two paddles to immersed amidship section of hull, | 1.000 to 8·042 |
| Proportion of the area of all the immersed paddles to immersed amidship section of hull, | 1.000 to 2·681 |
| Loss of effect by oblique action of the paddles, calculated as the squares of the sines of their angles of incidence on the water, | 21·64 per cent. |
| Slip of centre effort of paddles with 22 revolutions of wheels per minute, and 7 knots speed of vessel, | 30·38 per cent. |

BOILERS. *Plate I.*

Two iron boilers with single return ascending flues; boilers placed side by side.

| | |
|---|---|
| Length of each boiler, (exclusive of projection of steam chimney=7 inches,) | 15 feet 2 inches. |
| Breadth of each boiler, (exclusive of projection of steam chimney=8 inches,) | 7 " 0 " |
| Height of each boiler, (exclusive of additional height of steam chimney=6 feet 7 inches,) | 9 " 3 " |
| Contents of circumscribing parallelogram of each boiler, (exclusive of steam chimney,) | 982·04 cubic feet. |

| | |
|---|---|
| Total area of grate surface in both boilers, . . | 57·5 square feet. |
| Total area of heating surface in both boilers, . | 1280· " |
| Capacity of steam room in both boilers and steam chimney, | 541· cubic feet. |
| Capacity of steam room in boilers, steam chimney, and steam pipe, . . . . | 570· " |
| Cross area of the lower row of flues in both boilers, | 10·123 sq. feet. |
| Cross area of the two upper rows of flues in both boilers, | 13·090 " |
| Cross area of smoke pipe, . . . | 12·566 " |
| Height of smoke pipe above grates, . | 40 feet. |
| Mean pressure of steam above atmosphere in boiler per square inch, throttle ⅓d open, cutting off at ½, making 22 double strokes of piston per minute, giving 7 knots speed to vessel, being the general average of all steaming done, | 11·3 pounds. |
| Mean initial pressure of steam in cylinder per square inch above atmosphere by indicator under above conditions, | 6·3 " |
| Space comprised between cut-off valve and piston, (both cylin's,) | 8·563 cu. feet. |
| Consumption of anthracite coal per hour, with very moderate fan blast, under above conditions, . . | 840 pounds. |

PROPORTIONS.

| | |
|---|---|
| Proportion of heating to grate surface, . . | 22·261 to 1·000 |
| " grate surface to cross area of lower row of flues, | 5·681 " |
| " " " the two upper rows of flues, | 4·393 " |
| " " " smoke pipe, . | 4·576 " |
| " heating surface to cross area of lower row of flues, | 126·445 " |
| " " " the two upper rows of flues, | 97·784 " |
| " " " smoke pipe, | 101·862 " |
| Square feet of heating surface per cubic foot of space displacement of pistons, . . . | 17·958 |
| Square feet of heating surface per cubic foot of space displacement of pistons per double stroke of piston (22) per minute, | 0·816 |
| Square feet of grate surface per cubic foot of space displacement of pistons, . . . | 0·807 |
| Square feet of grate surface per cubic foot of space displacement of pistons per double stroke of piston (22) per minute, | 0·037 |
| Cubic feet of steam room per cubic foot of steam used per stroke of pistons, . . . | 12·900 |
| Consumption of anthracite coal with very moderate fan blast per square foot of grate surface per hour, . | 14·609 pounds. |
| Consumption of anthracite coal with very moderate fan blast per square foot of heating surface per hour, . | 0·656 " |
| Weight of steam produced per hour from water at a temperature of 100° F., by one pound of anthracite coal, exclusive of the steam required to work the fan blast, but inclusive of loss by blowing off, so as to keep the sea water at twice the natural density, of loss in nozzles, clearance, &c., taking the total cylinder pressure at 21 pounds per square inch, cutting off at half stroke, making 22 double strokes of pistons per minute, and burning 840 pounds anthracite per hour, | 8·008 " |
| Weight of steam produced per hour from one square foot of heating surface under above conditions, . . | 5·255 " |

PERFORMANCE.

The general mean of all steaming done at sea is, per hour, 7 knots of 6082⅔ feet each—a very low speed, when the consumption of fuel (840 pounds of anthracite per hour) is considered, in connexion with the dimensions of the vessel. A portion of this low result is undoubtedly due to the proportions of the wheel, which are of the common radial kind, and which, with a radius of only 8 feet, have the enormous immersion of 4 feet. When the vessel is rolling in an ordinary sea, or when she is

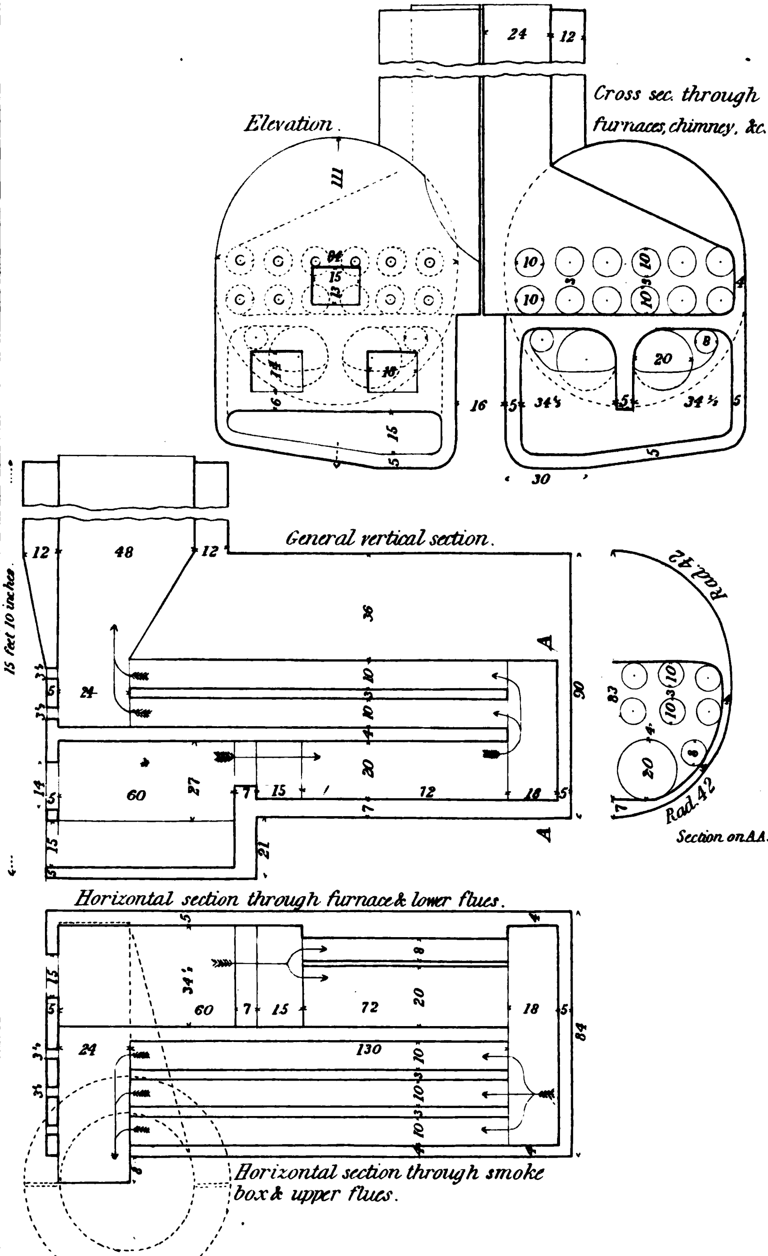
careened a little ($7\frac{1}{2}°$ from the horizontal) by sail, one wheel is immersed to the axis. In such a case, the loss of effect by the oblique action of the paddles is vastly greater than its calculated per centage for the average immersion of both wheels; while the slip of the two wheels remains about the same, the increased resistance of the deeper water to the depressed wheel, about balancing its decreased resistance to the lifted wheel. The absolute amount of paddle surface was also considerably too small. For a vessel of the *Walker's* size, the paddles should have been 7 feet long, instead of 6 feet; and the wheel 19 feet diameter, instead of 16 feet, retaining nearly the same immersion as at present. The paddles on the present wheel are at the periphery about 4 feet 2 inches apart, which distance, for a sea-going vessel with so small a wheel, may be considered too great.

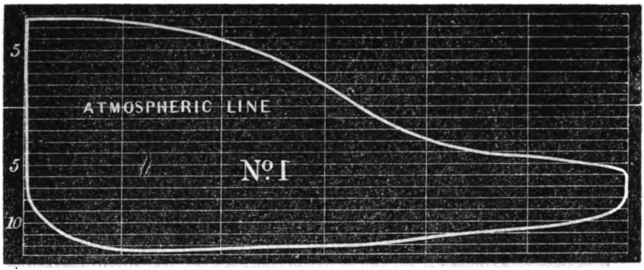
Of capacity of steam cylinders, there was a superabundance, but the boiler was too small to supply the intended quantity of steam, 15 pounds pressure per square inch above the atmosphere, cutting off at half stroke. Using the fan blast moderately, the boilers could with difficulty maintain an initial cylinder pressure of 6·3 pounds per square inch above atmosphere, burning 14·609 pounds of anthracite per square foot of grate per hour. The boilers were, however, well proportioned, giving the high evaporation of 8·008 pounds of steam per pound of coal, exclusive of the steam used for working the fan blast. This high evaporation may, I think, justly be attributed to the excellent proportions between the calorimeter (cross area of flues) and grate surface, and between the heating and grate surface. The least calorimeter was to the grate surface in the proportion of 1·000 to 5·681; while the heating was to the grate surface as 22·261 to 1·000. The disadvantage of a smoke pipe not high enough for good results with anthracite was compensated by a moderate fan blast. With a natural draft, the grates would consume 650 pounds of anthracite per hour, or 11·3 pounds per square foot. The advantages of a large calorimeter, are well illustrated in this boiler, proving beside, the high evaporative power of anthracite.

Indicator diagrams, Nos. 1 and 2, were taken nearly simultaneously from the front and back ends of the *starboard* cylinder. In No. 1, the mean effective pressure per square inch of piston was 12·83 pounds; in No. 2 it was 15·33 pounds; the boiler pressure being the same in both, viz: 10 pounds per square inch above the atmosphere; double strokes of piston, $22\frac{1}{2}$ per minute.

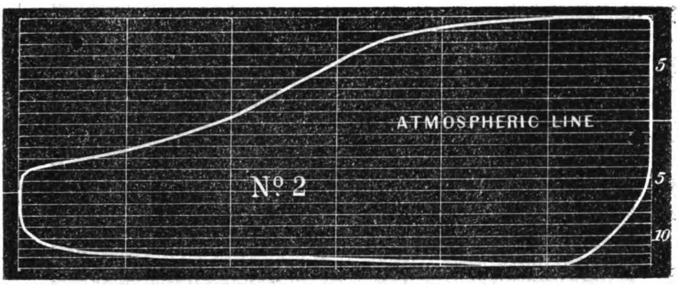
Indicator diagrams, Nos. 3 and 4, were taken immediately after Nos. 1 and 2, from the front and back ends of the *port* cylinder. In No. 3 the mean effective pressure per square inch of piston was 10·17 pounds; the boiler pressure being 11 pounds per square inch above atmosphere; double strokes of piston, 23 per minute. In No. 4, the mean effective pressure per square inch of piston was 12·67 pounds, the boiler pressure being 9 pounds per square inch above atmosphere; double strokes of piston, 22 per minute. In all four diagrams, the vacuum per gauge in condenser was 27 inches of mercury, and the throttle one-third open; steam being cut off at half stroke. These diagrams show in a very marked manner, the effect of throttling. They also show that the exhaust valve closed when the piston had yet about one foot of its stroke to perform, *cushioning* the steam through that distance, and that the steam valve had no *lead*.

# Boilers of the U.S. Steamer 'Walker.'

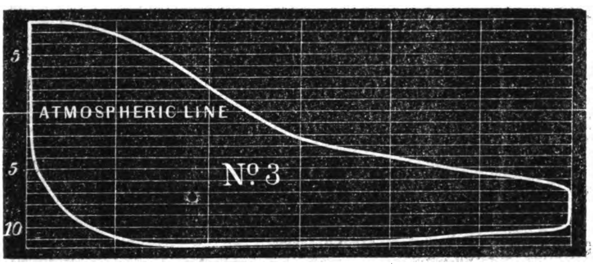




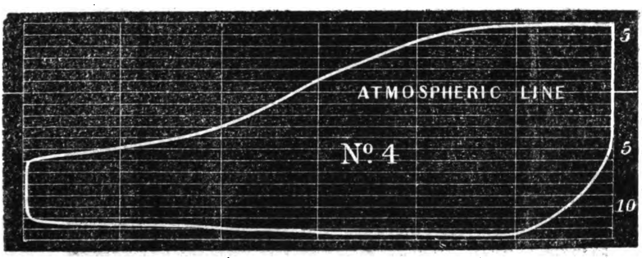
5
ATMOSPHERIC LINE
5
No. 1
10

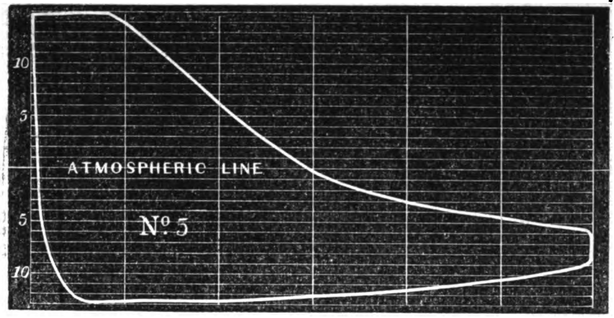
5
ATMOSPHERIC LINE
No. 2
5
10

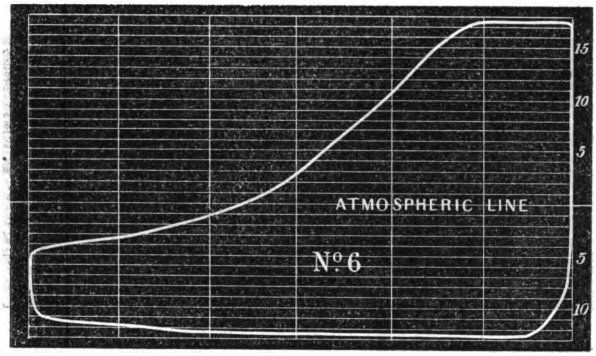



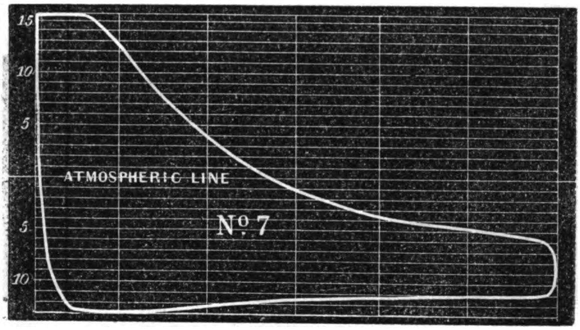
5
ATMOSPHERIC LINE
5
No. 3
10

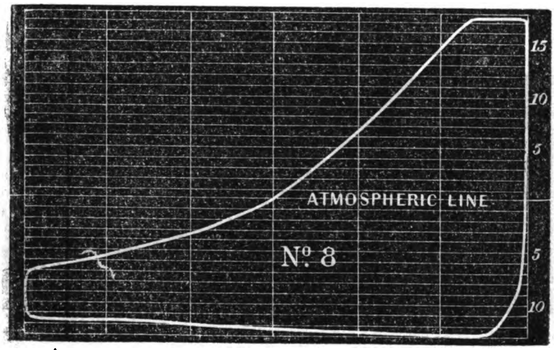



5
ATMOSPHERIC LINE
5
No. 4
10


10
5
ATMOSPHERIC LINE
5
Nº 5
10


15
10
5
ATMOSPHERIC LINE
5
Nº 6
10


15
10
5
ATMOSPHERIC LINE
5
Nº 7
10


15
10
5
ATMOSPHERIC LINE
5
Nº 8
10

This manner of using steam proving unsatisfactory, the cylinders were altered as shown in indicator diagrams, Nos. 5, 6, 7, and 8. Nos. 5 and 6 were taken in succession from the front and back ends of the *starboard* cylinder; the steam pressure in boiler per square inch above atmosphere was respectively 15 and 18 pounds; double strokes of piston, 21 per minute. In No. 5, the mean effective pressure per square inch of piston was 14 pounds; in No. 6, 17·33 pounds; the steam in starboard cylinder was cut off at one-sixth the stroke from the commencement.

Nos. 7 and 8 were taken immediately after Nos. 5 and 6, from the front and back ends of the *port* cylinder; the steam pressure in boiler per square inch above atmosphere was respectively 16 and 17 pounds; double strokes of piston, 21 per minute. In No. 7 the mean effective pressure per square inch of piston was 13.33 pounds; in No. 8, 14·83 pounds; the steam in port cylinder was cut off at one-ninth the stroke from the commencement. In all of these diagrams the vacuum in condenser per gauge was 28 inches of mercury; throttle wide open.

I have no account of the fuel now used, but am informed that no difficulty is found in keeping steam; the corners of the diagrams are also much squarer than before, and the expansion curve shows the cylinder valves, which were of the "balance puppet" kind, to have been tight.

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For the Journal of the Franklin Institute.

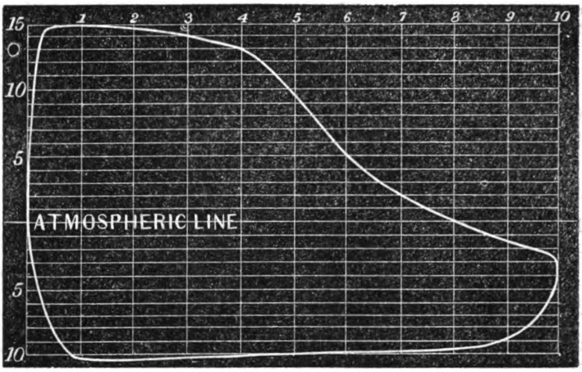
## *Performance of the U. S. Mail Steamer Arctic, on her Eighth Voyage from New York to Liverpool.* By B. F. Isherwood, Chief Eng. U. S. Navy.

| Day. | Date. 1852. | Average steam pressure in boiler. Pounds per sq. in. | Average revolutions per minute. | Total revolutions made per day. | Time h. m. | Anthracite coal. Tons burn'd per day. | Geographical miles ran per day. |
|---|---|---|---|---|---|---|---|
| 1st | Feb. 8th. | 17·0 | 14·5 | 20,550 | 23 45 | 85 | 300 |
| 2d | " 9th. | 16·7 | 14·3 | 20,167 | 23 30 | 75 | 310 |
| 3d | " 10th. | 17·5 | 15·3 | 21,704 | 23 34 | 80 | 325 |
| 4th | " 11th. | 17·5 | 15·8 | 22,419 | 23 30 | 88 | 331 |
| 5th | " 12th. | 17·0 | 15·7 | 22,254 | 23 25 | 89 | 336 |
| 6th | " 13th. | 16·1 | 15·3 | 21,497 | 23 31 | 89 | 234 |
| 7th | " 14th. | 17·0 | 16·4 | 23,104 | 23 25 | 92 | 316 |
| 8th | " 15th. | 17·0 | 16·7 | 23,440 | 23 23 | 90 | 307 |
| 9th | " 16th. | 16·7 | 16·5 | 23,237 | 23 22 | 91 | 301 |
| 10th | " 17th. | 16·5 | 17·5 | 22,594 | 21 25 | 87 | 295. |
| | Totals, | | | 220,966 | d. h. m. 9 16 41 | 866 | 3055 |
| | Means, | 16·9 | 15·827 | | | 8337·3 lbs. per hour. | 13·13 pr h'r. |

*Indicator Diagram.*—The accompanying indicator diagram shows the mean performance. When taken, steam pressure in boiler above atmos-

phere per square inch, 17 pounds; double strokes of piston per minute, 16; mean effective pressure on piston throughout the stroke, 16·9 pounds; throttle partly closed; calculating the horse power developed by the engine for this pressure and for 15·827 double strokes of piston per minute, we have, area of both pistons, 14176·46 square inches; stroke of piston, 10 feet; mean effective pressure per square inch of pistons, 16·9 pounds; speed of piston per minute, 316·54 feet.

$$\frac{14176{\cdot}46 \times 16{\cdot}9 \times 316{\cdot}54}{33000} = 2298{\cdot}1 \text{ horse power.}$$




*Evaporation by the Boilers.*—The mean initial steam pressure in the boilers may be taken at 14·3 pounds per square inch above atmosphere, cut off at $4\frac{1}{2}$ feet from commencement of stroke of piston. Space displacement of both pistons filled per stroke with steam, 443·016 cubic feet, to which add space comprised between cut off valve and piston at one end of cylinder, (for both cylinders,) 25 cubic feet, making a total bulk of 468·016 cubic feet of steam of the total pressure of 29 pounds per square inch, used per stroke of piston, which per hour would become (468·016×15·827×2×60) 888874·708.

The loss by *blowing off* at $\frac{2}{32}$, will be as follows: neglecting small corrections, total heat of steam, 1202° F.; temperature of feed water, 100°F.; temperature of steam of 29 pounds total pressure, 249·6°; then, 1202° —100°=1102°; and, 249°·6—100=149·6°. Sum of the caloric utilized in steam and lost in *blowing off*, (1102°+149°·6)1251°·6, of which 1102° is 88 per cent. and $\frac{888874{\cdot}708 \times 100}{88} = 1010084{\cdot}9$ total cubic feet of steam of 29 pounds total pressure generated per hour. The relative volumes of this steam and the water from which it is generated, is 911· and 1, and $\frac{1010084{\cdot}9}{911} = 1108{\cdot}765$ cubic feet of sea water evaporated per hour, which at 64·3 pounds per cubic foot, would amount to 71293·59 pounds of water evaporated per hour by 8337·3 pounds of anthracite, or 8·55 pounds of water per pound of coal.

This is perhaps a higher result than has ever before been attained by a marine boiler making a long trip, and fired and cleaned in the ordinary manner by ordinary firemen. It will be observed that the results obtained

under the above practical conditions, are very different from what would be given by a more experimental trial of a few hours on shore, with a small quantity of fuel skilfully burned, and all avenues of losses carefully guarded. It must also be considered that these boilers have been in use for some time, and are probably considerably encrusted with scale.

The features of these boilers are, 1st, The heating surface is nearly all vertical surface.

2d, The proportion of calorimeter or draft area to the grate surface is very large at first, and diminishes to nearly one half in the chimney, being at front of tubes, 1·000 to 5·205; at back of tubes, 1·000 to 7·840; in chimney, 1·000 to 10·000.

3d, The proportion of heating to grate surface is very large, being $33\frac{1}{4}$ to 1.

4th, The hot gases are kept by means of a hanging bridge in contact with the heating surface, until their temperature is properly reduced.

5th, A very great height of chimney, being 75 feet above grates, giving a good draft even with the greatly diminished chimney calorimeters; the rapidity of the combustion is not remarkable as either fast or slow, being at the rate of 13·13 pounds of coal per square foot of grate per hour.

6th, A double tier of furnaces, one furnace in the upper and one in the lower tier, mingle their hot gases at the same bridge. By alternate firing below and above, the temperature of the mingled gases is always kept sufficiently high for combustion, while practically, no inconvenience is found in firing furnaces so arranged.

*Slip of the Paddle Wheel.*—The circumference of the centre of effort of the paddles is 107·3 feet. The mean slip was, therefore,

$$107{\cdot}3\times15{\cdot}827\times60=101894{\cdot}226 \text{ ft.}=\text{sp. of cen. effort of paddles p. h.}$$
$$13{\cdot}13\times6140 \quad = 80618{\cdot}200 \text{ ft.}=\text{speed of vessel per hour.}$$
$$21276{\cdot}026 \text{ ft.}=\text{slip per hour, or } 20{\cdot}88 \text{ per cent.}$$

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For the Journal of the Franklin Institute.

## *Propeller Steamers between Boston and Halifax.*

The Boston merchants, after chaining their tri-mount City to the surrounding States as well as the Canadas, by the aid of their seven magnificent railroads, have concluded to extend the sphere of their mercantile enterprise, by launching into a new element, in the establishment of a line of propeller steamers, to ply between Boston and Halifax; and to that end, Messrs. Clark & Jones have contracted for a propeller as the pioneer, of the dimensions herein given.

The trade between Boston and Halifax has heretofore been carried on by a line of sailing vessels, belonging to the same gentlemen, except what may have been done by the English Mail Steamers.

The manifest advantages of propellers over sailing vessels is so plain, from the fact, that the trips of the latter must necessarily be without regularity, while those of the former, under all ordinary circumstances, can be be depended on, that the surprise is, that a line of this description has not been put in operation before this. Many passengers from Halifax, as

well as other parts of Nova Scotia, coming to Boston, have heretofore crossed to St. Johns, N. B., and then taken steamers to Boston; a great portion of this travel will undoubtedly come by this new line. A fair proportion of the travel also between the Canadas and Nova Scotia will also, doubtless, prefer the route to Boston by railroad, and thence by this line to Halifax. This accommodation of passenger traffic, and a continually increasing trade with the Provinces, furnish good ground for the belief, that the enterprise will prove successful. One trip a week is anticipated.

The following are the dimensions of the hull, engines, &c.:

HULL.

| | |
|---|---|
| Length on deck, | 171 feet. |
| " between perpendiculars, | 168 " |
| Breadth of beam, | 28 " |
| Depth of hold, | 18 " 6 inches. |
| Tonnage, | 700 tons. |

Three-masted schooner rigged, with foresail and foretopsail. Hollow lines, with an exceeding fine entrance.

Builder—Mr. J. D. Curtis, of Medford, Massachusetts.

DIMENSIONS OF ENGINES, &c.

| | |
|---|---|
| Two cylinders, inverted. | |
| Diameter of cylinders, | 44 inches. |
| Length of stroke, | 33 " |
| Diameter of air pumps, | |
| Length of stroke, | 18 " |
| Slide Valves, | |
| Diameter of shaft in journals, | 10 " |
| Diameter of propeller, | 8 feet 4 " |

Air pumps worked by beams from cross-head. S.

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## *Baillie's Volute Springs.**

The only springs shown in the Great Exhibition, which were lucky enough to gain a prize, were Baillie's volutes; and it is not perhaps too much to add, that their simplicity and excellence fully entitle them to this distinguishing honor. The material of which they are made is flat steel with parallel edges, but tapering in thickness from one end to the other. Such pieces of metal are wound spirally into a cone, so as to sustain pressure and deflexion in the direction of the breadth of the metal. In bringing the invention before the readers of this *Journal*, we have selected as illustrations two examples of the springs as applied to railway purposes.

Fig. 1 is a longitudinal section of a double-spring railway passenger carriage-buffer. The outer cylinder, A, bolted to the front buffer beam, has within it the two volutes, B C, set with their apices towards each other, upon a guide-spindle fastened to the cylinder bottom, this spindle having upon it a bearing disk to receive the pressure from the two springs, when forced towards each other. The short sliding cylinder, D, carrying the buffer disk on its outer end, is fitted to slide within the open end of the spring cylinder, A, and encircles one of the springs, B, a diaphragm being cast across the cylinder, D, to communicate the external pressure to the base of the spring, and to act as a further guide, by passing the

* From the London Practical Mechanic's Journal, December, 1851.

spring-guide spindle through its centre. It thus forms a most compact buffer, one or more volutes being enclosed in the cylinder according to the extent of range required. The springs may also be fitted up by simply stringing two or more springs on the rods beneath the carriage body, and as the volutes do not interfere with the timbers of the trussed framing, a more simple and rigid structure is attainable with a smaller amount of woodwork.

For engines and goods wagons a single spring only may be used, the most economical fitting being simply to fix them on the buffer-rod beyond the end framing, and if the springs need any protection, the timbers may be conveniently contrived with a hollow to receive them.

Fig. 1.—1-12th.

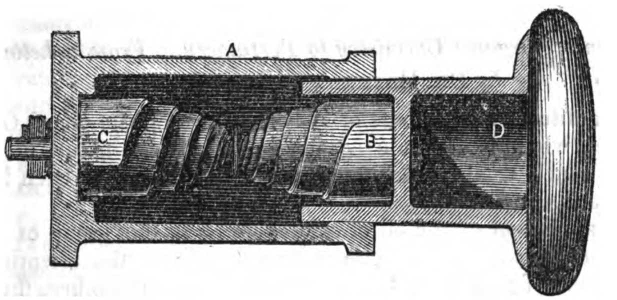


Fig. 2.—1-24th.

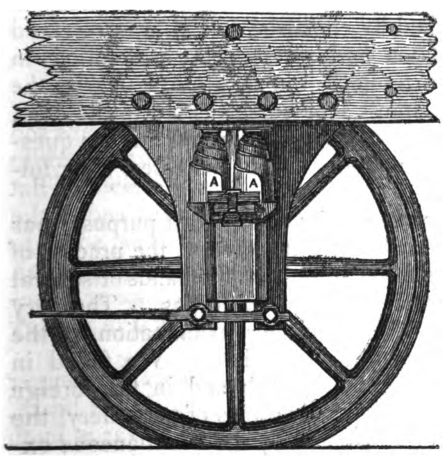


Fig. 3.—1-32d.

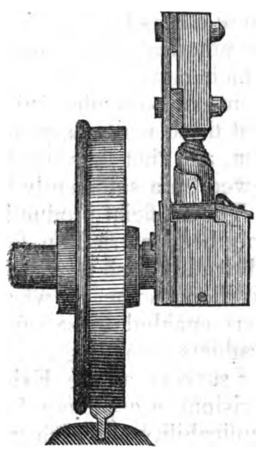


Fig. 2 exhibits a side elevation of a portion of a wagon frame, with its wheel and axle-box, to show the application of the volutes as bearing springs. Fig. 3 is an end elevation of the same, drawn to a slightly smaller scale. The top of the axle-box has a short cross-bar, which answers to receive the bases of a pair of springs, A, set one on each side the line of the axle's centre, on guide-spindles—the apices, of course, abutting against the lower side of the frame. One spring in the centre may be used instead of two, but the duplex arrangement is much more efficient.

As drawing springs, they are applied by passing through them a bolt with adjustable nuts, to convey the pressure to the apex of the volute. If placed at or near the centre of the carriage, they will act both ways, by using a short length of tube with a slot in the draw-bar. The latter can in this way lengthen itself, rendering great assistance to the engine in getting under way with a heavy train. It is claimed for this form of spring, that it is capable of sustaining equal loads with one-third the weight of steel necessary in the common spring. Although thus light, the peculiarity of action in applying the pressure edgewise to the coils, renders them remarkably free from liability to fracture, whilst, whatever amount of force is sustained by them, the coils are always brought up to a firm bearing at the end of their traverse.

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## *Application of Organic Chemistry to Perfumery. From a Letter written by* Dr. Hofmann *to* Prof. Liebig.*

The beautiful investigations of M. Cahours upon the oil of *Gualtheria procumbens*, which have made us acquainted with the nature of this compound, so much used in perfumery, appears not to have been lost sight of in the arts.

The arrangement of the oil of winter-green in the group of the compound ethers could not do otherwise than direct the attention of the manufacturers of perfumery to this extensive class of bodies, the number of which is still further daily increased by the active energy devoted to the field of organic chemistry. The remarkable fruity odor of many of these ethers had not been overlooked by chemists; but it was reserved for practical men to make the selection and ascertain the proportions in which certain of these compounds resembled in so great a degree the aroma of particular fruits, that we almost feel ourselves led to the idea, that these very compounds are the cause of the odor of the fruits in question, and that they would be found in them, if the processes were followed on a sufficiently large scale.

The artificial production of aromatic oils for commercial purposes has only been carried on for the last few years; but although the process of fabrication is so new, yet it appears to be already in the hands of several distillers, some of whom make tolerably large quantities. The jury were enabled to satisfy themselves of this, in their examination of the products belonging to this department in the Exhibition. We found in our surveys at the Exhibition, both in the English and in the foreign divisions, a copious selection of these chemical articles of perfumery, the applicability of which was moreover illustrated by the simultaneous exposition of the confectionary flavored with them.

Unfortunately, most of these oils were only sent in small quantities, so that the specimens which I was enabled to obtain, in few cases only allowed of accurate examination.

The compound most frequently exhibited was a liquid labelled "*pear oil*," which on examination was shown to be an alcoholic solution of pure *acetate of amylic oxide*. As I had not enough of the compound to allow of its sufficient purification for ultimate analysis, I decomposed it with

*From the Chemical Gazette, London, March 1, 1851.

potash, when free fusel oil separated, and the acetic acid was determined in the form of the silver salt. The acetate of silver gave per cent.

| Theory. | Experiment. |
|---|---|
| 64·68 | 64·55 |

The acetate of amylic oxide, when obtained by the ordinary process, (one part of sulphuric acid, one part of fusel oil, and two parts of acetate of potash,) evolved a remarkably fruity odor; but the agreeable odor of the Jargonelle pear was not distinct until it was diluted with 6 vols. of alcohol. On close inquiry of the exhibitors, I ascertained that tolerably large quantities of this oil (in one case 15–20 lbs. weekly) are manufactured. It is principally used for flavoring pear drops, which are much admired in England, and which consist almost entirely of barley sugar.

Next came the *apple oil*. As the examination shows, it is nothing more than valerianate of amylic oxide, and every one is at once reminded of the insupportable odor of rotten apples, which fills the laboratory, in making valerianic acid. When the crude distillate of this operation is treated with dilute alkali, the valerianic acid is separated, and an ether is obtained, the solution of which in about 5 or 6 vols. of alcohol possesses a most agreeable aroma of apples.

The essence in greatest quantity was the *pine apple oil*, which, as you are aware, is only butyrate of oxide of æthyle. This compound, also, like the two above, does not evolve the agreeable odor until diluted with a large amount of alcohol. Butyric ether, which in Germany is frequently added to the inferior kinds of rum, is principally used here for flavoring a kind of lemonade (pine apple ale). For this purpose it is however seldom prepared from pure butyric acid, but generally by merely saponifying the butter, and distilling the soap with concentrated surphuric acid and alcohol. The liquid thus obtained of course contains other ethers besides butyric ether, but it may be used in this state for flavoring. The specimen which I analyzed appeared however to be the pure ether prepared from butyric acid. When decomposed by potash, and converted into a silver salt, it yielded—

| Experiment. | Theory. |
|---|---|
| 55·33 | 53·38 per cent. of silver. |

The so called *cognac oil* and *grape oil* were sent both by English, as also French and German exhibitors. They appear to be used pretty commonly for imparting the favorite cognac odor to low brandies. Unfortunately, the specimens exhibited were too small in quantity to allow of my instituting an accurate examination of these oils. The cognac oil especially was in very small quantity; on the addition of water to the whole of the sample, a few drops only separated, and these consisted of a mixture. The grape oil is also an amyle compound, dissolved in much alcohol; for when treated with concentrated sulphuric acid, the oil, freed from alcohol by washing with water, yielded sulphate of amylic oxide, which was identified by the analysis of the barytic salt. It yielded 45·82 per cent. of sulphate of baryta.

The crystallized amylo-sulphate of baryta with two equivs. of water, analyzed by Cahours, and again recently by Kekulé, contains 45·95 per cent. of sulphate of baryta. It is certainly remarkable, that we see here

a body, which on account of its insupportable odor is separated from brandy with the greatest care, again applied in an altered form to flavor this beverage.

I must also allude to the *artificial oil of bitter almonds.* When Mitscherlich, in 1834, discovered nitro-benzole, he little thought, after twenty years, to find this body in an industrial exhibition. He certainly, at that time, pointed out the remarkable resemblance which the odor of nitro-benzole had to that of oil of bitter almonds; but the only sources for obtaining benzole at that time, viz: the oil of compressed gas and the distillation of benzoic acid, were much too expensive, and put an end to the idea of substituting the use of nitro-benzole for oil of bitter almonds. However, as you recollect, by means of the well known aniline reaction, I showed with the utmost certainty the presence of benzole in the common light oils of coal tar, which had frequently been previously suspected; and in 1849, C. B. Mansfield showed, by a careful investigation, that benzole may be procured easily, and in large quantity, from oil of coal tar. In his memoir, which contains many valuable details upon the practical applications of benzole, the possibility that the fragrant nitro-benzole may be obtained in larger quantities is alluded to. As the Exhibition shows, this remark has not been lost sight of in the arts. Among the articles of French perfumery, with the title of *artificial oil of bitter almonds*, and the fanciful name of *essence of Mirbane*, there were several specimens of oils, which on accurate examination proved to consist of more or less pure nitro-benzole. I was not enabled to ascertain accurately the extent of this fabrication; but it appears to me by no means inconsiderable. Here, in London especially, tolerable quantities of this artificial oil of bitter almonds are prepared. The very simple apparatus used is that proposed by Mr. Mansfield. It consists of a large glass worm, the upper end of which branches into two tubes, which are provided with funnels. A stream of concentrated nitric acid flows slowly through one of these funnels, whilst the other is for the benzole (which for this purpose need not be absolutely pure.) At the point at which the tubes of the funnels are united, the two bodies come in contact; the chemical compound formed becomes sufficiently cooled in passing through the worm, and only requires to be washed with water, and finally with some weak solution of carbonate of soda, to be ready for use. Although the nitro-benzole closely resembles oil of bitter almonds in physical properties, it possesses however a somewhat different odor, readily recognised by a practised hand. However, it answers well for scenting soap, and would be extensively applicable for confectionary and for culinary purposes. For the latter purpose it has the special advantage over oil of bitter almonds, that it contains no prussic acid.

Besides these, several other similar products were exhibited, but most of them were of too compound a nature, and in too small a quantity, to allow of their composition being accurately determined. In the case of many of these essences, their resemblance to the aromas specified was very doubtful.

The application of organic chemistry to perfumery is still in its infancy; and we may expect that a careful survey of those ethers and etherial compounds with which we are at present acquainted, and those which

are daily being discovered, will lead to further results. The interesting caprylic ethers, which M. Bouis has lately discovered, are remarkable from their extremely aromatic odor, (thus the acetate of caprylic oxide possesses an odor as strong as it is agreeable,) and promise, if they can be obtained in larger quantities, to yield new materials for perfumery.—*Ann. der Chem. und Pharm., vol.* LXXXI, *p.* 87.

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*On the Expansion of some Solid Bodies by Heat.* By HERMANN KOPP.*

The method of experiment adopted by Prof. Kopp in his laborious and valuable investigation is to ascertain the specific gravities of a body when immersed in fluids of various temperatures, and thence, by means of the known expansion of the fluid, to determine the cubic expansion of the body. A flask was taken furnished with a carefully ground glass stopper; and the first point to be ascertained was, "what weight of water, freed from air, and at different temperatures, was the flask able to contain?" For low temperatures, the flask and its contained water were placed in a large vessel filled with the same fluid, the temperature of which was shown by two thermometers immersed in it. When it was certain that the flask had assumed the temperature of the surrounding water, the stopper (which was preserved at the same temperature,) was set on, the flask dried, and then carefully weighed. For temperatures of 40° or 50° C., the flask was immersed in a large beaker filled with water, which again was immersed in a second larger beaker, also full of water; the latter was heated, and after some time the water surrounding the flask acquired a uniform temperature of the required height; the glass stopper, which up to this time had been preserved in water of the same temperature, was now set on, the flask removed, dried, and weighed as before. When the quantity of boiling water held by the flask was to be ascertained, the latter was properly fixed in the neck of a large bolt-head, in which a quantity of water was kept violently boiling. The flask was here surrounded by steam, and precautions were taken to prevent any inconvenient loss of heat by radiation or by contact with the surrounding air.

Having ascertained the amount of water embraced by the flask at numerous temperatures, a proceeding exactly similar was followed to ascertain the specific gravity of the substance. The flask with the substance alone was first weighed; the flask was then filled with water, the air completely expelled by boiling, and then the weight of the known quantity of solid substance, plus the weight of the water necessary to fill the flask at various temperatures, was ascertained.

Suppose the weight of the flask of water at the temperature $t^0$ to be W, the weight of the solid substance to be examined to be P., and the weight of the water and substance which together filled the flask at $t^0$ to be S, then we have

$$\frac{P}{W-(S-P)}=D_t,$$

where $D_t$ expresses the specific gravity of the substance referred to water of the temperature $t^0$ as unit. Further, is $\frac{D_t}{V_t}=D_0=$ the specific gravity

* From the Lond., Edinb., and Dublin Philosoph. Magazine, April, 1852.

of the solid substance at $t^0$ referred to water at $0^0$ as unit, where $V_t$ expresses the volume which one volume of water at $0^0$ assumes on being heated to $t^0$.

Supposing that for two temperatures $t$ and $t'$, the former of which is lower than the latter, the specific gravities $D_0$ and $D_0'$ respectively be found, then is the cubic expansion of the body

$$= \frac{1}{t'-t} \cdot \left( \frac{D_0}{D_0'} - 1 \right)$$

The expansion of water by heat was made the subject of special inquiry, and numerous substances were examined whose linear expansion had been determined by other methods and other men; the agreement between M. Kopp's results and those already determined furnishes a proof that the method pursued and precautions taken may be relied on.

We here transcribe a tabular statement of M. Kopp's results, premising that each is the mean of several experiments:—

| Substance, | Formula. | Cubic expansion for 1°. | Determined by means of |
|---|---|---|---|
| Copper, | Cu | 0·000051 | Water. |
| Lead, | Pb | 0·000089 | " |
| Tin, | Sn | 0·000069 | " |
| Iron, | Fe | 0·000037 | Mercury. |
| Zinc, | Zn | 0·000089 | Water. |
| Cadmium, | Cd | 0·000094 | " |
| Bismuth, | Bi | 0·000040 | " |
| Antimony, | Sb | 0·000033 | " |
| Sulphur, | S | 0·000183 | " |
| Galena, | PbS | 0·000068 | " |
| Zinc blende, | ZnS | 0·000036 | " |
| Iron pyrites, | $FeS^2$ | 0·000034 | " |
| Rutile, | $TiO^2$ | 0·000032 | " |
| Oxide of tin, | $SnO^2$ | 0·000016 | " |
| Oxide of iron, | $Fe^2O^3$ | 0·000040 | " |
| Magnetic ore, | $Fe^3O^4$ | 0·000029 | " |
| Fluor spar, | CaFl | 0·000062 | " |
| Arragonite, | CaO, $CO^2$ | 0·000065 | " |
| Calcareous spar, | CaO, $CO^2$ | 0·000018 | " |
| Bitter spar, | CaO, $CO^2$+MgO, $CO^2$ | 0·000035 | " |
| Carbonate of iron, | Fe (Mn, Mg) O, $CO^2$ | 0·000035 | " |
| Heavy spar, | BaO, $SO^3$ | 0·000058 | " |
| Cœlestine, | SrO, $SO^3$ | 0·000061 | " |
| Quartz, | $SiO^3$ | 0·000042<br>0·000039 | "<br>Mercury. |
| Orthoklas, | KO, $SiO^3$+$Al^2O^3$, $3SiO^3$ | 0·000026<br>0·000017 | Water.<br>Mercury. |
| Glass, soft soda glass, | | 0·000026 | Water. |
| Glass, soft soda glass, another kind, | | 0·000024 | Mercury. |
| Glass, hard potash glass, | | 0·000021 | Mercury. |

Taking every possibility of error into account, M. Kopp considers that we may infer with certainty from the preceding numbers, that the expansion of solid substances is by no means determined by their chemical nature. The difference between the coefficients of expansion for arragonite and calcareous spar is so great as to destroy all hope of establishing any relation of the kind. Neither does the expansion appear to depend altogether on the arrangement of the atoms; for although bitter

spar and carbonate of iron agree, and heavy spar differs but little from cœlestine, in the cases of carbonate of iron and carbonate of lime, and of rutile and oxide of tin, no such agreement exists. The table further shows that there are many non-metallic substances which expand as much under the action of heat as the metals themselves.—*Ann. der Chem. und Pharm., Vol.* LXXXI, *No.* 1, *p.* 1–67.

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## *Description of a New Method of Preparing Negative Photographic Paper.* By M. Gustave Legray.*

Persons who are engaged in the process of photography on paper, are well aware of the difficulty of obtaining paper of a good quality, and suitably adapted to receive uniformly the requisite chemical preparations.

After having made a great number of trials, I have succeeded in meeting this difficulty by the use of a size adapted, I may say, to any kind of paper.

Paper thus prepared so much facilitates the photographic process, and helps to assure a satisfactory result, that I make no doubt it will be generally adopted.

The substance used for this size is virgin wax, which is kept at a temperature of 100° centigrade, in a large flat vessel, and the paper is immersed therein until completely saturated with the wax. The sheet of paper is then withdrawn, and laid between several pieces of blotting paper, over which a moderately heated iron is passed, which causes the blotting paper to absorb the superfluous wax. If the paper is properly prepared, there will be no gloss whatever on its surface, and it will be perfectly transparent.

The waxed paper is then immersed in a warm solution, composed as follows:

| | | |
|---|---|---|
| 1000 | parts of | rice water. |
| 40 | " | sugar of milk. |
| 15 | " | iodide of potassium. |
| 0·80 | " | cyanide of potassium. |
| 0·50 | " | fluoride of potassium. |

The sheet of paper should be laid in this solution for half an hour, and it may then be withdrawn, and hung up to dry.

The paper is then immersed in a clear solution of aceto-nitrate of silver, which is thus formed:

| | | |
|---|---|---|
| 300 | parts | distilled water. |
| 20 | " | azotate of silver. |
| 24 | " | crystallizable acetic acid. |
| 5 | " | animal charcoal. |

The animal charcoal serves to render the paper more susceptible to receive impressions, and decolorizes the solutions when they have been previously used. The paper should remain three minutes in this solution, and in order to insure contact with the liquid, the two sides of the sheet should be rubbed over with a brush. The paper is then washed several times with distilled water, and well dried between pieces of blotting paper. Paper thus prepared may be taken immediately into the dark chamber, and it is not necessary to subject the image to the action of

* From the London Mechanics' Magazine, for January, 1852.

gallic acid on its removal from the camera; this may be deferred till the evening, or even the next day, or the day following.

The paper may be kept in a dark place for more than a fortnight without undergoing any alteration, and in this respect offers greater advantages than any of the photographic papers hitherto known. The solution of gallic acid is composed of 1 part of gallic acid, half part (0·5) of azotate of silver, and 200 parts of distilled water. The image is fixed as usual by hydro-sulphite of soda.

I have submitted to the Academy a series of specimens obtained by this process. It is so easily put in practice that, during a mission which I have just fulfilled for the Commission of Historical Monuments, I have often taken twenty-five or thirty photographs a day.

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*Improvements in the Manufacture of Glass, Porcelain, Earthenware, China, and Artificial Stone.*—Patented October 2, 1851, by W. Hodge, of Cornwall.*

For the purposes above specified, hornstone porphyry is adopted by the patentee as a material which has not been hitherto used.

*Claim.*—The application of this material, called elvan, to the manufacture of glass, porcelain, earthenware, china, and artificial stone.

For the manufacture of glass, it is powdered, washed, and mixed with other pulverized materials in the melting pot.

For the manufacture of porcelain, &c., it may be used alone or in combination with other materials. It is powdered, brought to a plastic state, moulded, dried, and fired in the usual way. It can likewise be employed for making glazes.

For the manufacture of artificial stone, it is used alone or combined with broken stone, and reduced to a plastic condition, moulded into blocks, dried, and fired in the usual manner.

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*Experimental Researches in Electricity. Twenty-ninth Series.* By Michael Faraday, Esq., D. C. L., F. R. S., &c.†

In the present series of researches the author endeavors in the first place to establish the principles he announced in the last, with regard to the definite character of the lines of magnetic force, by results obtained experimentally with the magnetic force of the earth. For this purpose he reverts to the thick wire galvanometer before described, and points out the precautions respecting the cleanliness of the coils, the thickness and shortness of the conductors, the perfect contacts, effected either by soldering or cups of mercury; and marks the value of double observations, i. e. observations afforded on both sides of zero. The nature of the impulse on the needles is pointed out; being not that of a constant current for a limited or unlimited time, but of a given amount of electricity exerted, either regularly or irregularly, within a short period; and it is shown

* From the London Civil Engineer and Architect's Journal, May, 1852.

† From the London, Edinburgh, and Dublin Philosophical Magazine, April, 1852.

experimentally that such impulses produce equal results of deflexion, and also that when two or more such impulses are given within a limited time, the whole arc of swing is nearly proportional to their number; so that the amount of deflexion, *within certain limits*, indicates directly, nearly the proportion of electricity which has passed as a current through the instrument.

If a wire be formed into a square of 12 inches in the side, and then fixed on an axis passing across the middle parallel to two of its sides, and if, when that axis is perpendicular to the line of dip, the whole is rotated, then two of the sides of the rectangle will, in one revolution, twice intersect the lines of force of the earth passing across or through one square foot of area. The currents then tending to move in the upper and lower parts of the rectangle, will conjoin to urge one current through the wire; and if this wire be cut at one place close to the axis, and be there connected with a commutator of simple construction, which is described in the paper, the currents round the rectangle may be conveyed away to the galvanometer, and there measured. Such a rectangle, constructed of copper wire one-twentieth of an inch in thickness, gave a certain arc of swing for one revolution. If five or ten revolutions were made, within the time of vibrating of the needle, nearly five or ten times this amount of deflexion was produced; the mean result, in the present case, was $2^{\circ}{\cdot}624$ per revolution. When the same length of the same wire was arranged in oblong or oblate rectangles, so as to diminish the inclosed area in different directions as regarded the axis of revolution, still the deflexion was in every case proportional to the areas included; showing that the effect produced was proportional to the number of lines of force intersected by the moving wire. The same result was obtained when two squares having areas in the proportion of 1 to 9, were employed.

When squares of the same area were formed of copper wire of different thicknesses, then the effects of obstruction in the conducting part of the system were brought out and measured. Thus, with wires which were 0·05, 0·1, and 0·2 of an inch in diameter, and therefore in mass as 1, 4, and 16, the deflexions were 1, 2·78, and 3·45; a result almost identical with that obtained for the same wires by the use of loops and a local magnet in the former researches. When two equal rectangles were compared, one containing a single circuit of 4 feet of wire 0·1 in thickness, and the other four circuits of 16 feet of wire 0·05 in thickness, then the first was found to evolve the largest quantity of electricity; but the second, electricity of the highest tension, by the same amount of motion: the accordance of these results with the principles advanced is pointed out. The author then refers to the use of wire rings of one or many convolutions, and indicates cases in which they may supply valuable means of experimental inquiry.

The relative amount and disposition of the forces of a magnet when it is alone, or associated with other magnets, forms the next point in the present paper; and a distinction is first taken between ordinary magnets, which are influenced much by other magnets, so that the amount of their external force varies greatly, and those which are very hard, where this influence is reduced to little or nothing. The power of a given magnet

was measured according to the method described in the last series, by a loop once passed over its pole. A given hard magnet placed in an invariable position, being thus estimated, was found to have a force equivalent to 16°·3 of deflexion. Another magnet, having a power of 25°·74, was then placed close to the first in different positions, with like or unlike poles near together, so as to tend sometimes to exalt its power and at other times to depress it; and the results observed. In the extremest favorable case, namely, when the two were conjoined as a horse-shoe magnet, the force of the first magnet was only raised 2°·45, which fell directly the dominant magnet wes removed; in the corresponding adverse case the depression was only 1°. A very hard magnet, made by Dr. Scoresby, of 6°·88 power, when under the influence of another of double its power, was not sensibly affected either way. When under the influence of one of six times its force, it could be affected to the extent of nearly 1°. Ordinary magnets could be affected to the extent of one-half of their power or more; and indeed in extreme cases can be altogether overruled and inverted.

From these results the author concludes, that, with perfect unchangeable magnets, the lines of force (as before defined) of different magnets in favorable positions, coalesce; that there is no increase of the total force by this coalescence; the sections between the associated poles giving the same sum of power as the sections of the lines of either magnet alone; that as the external amount of force of the magnet is not varied, neither is the internal amount at all changed; that the increase of power upon a magnetic needle, or a piece of soft iron, placed between two opposite favorable poles, is caused by concentration of the lines which before were diffused, and not by the addition of the power represented by the lines of force of one pole to that of the lines of force of the other. There is no more power represented by *all* the lines of force than before, and a line of force is not in itself more powerful because it coalesces with a line of force of another magnet. In this and in other respects, the analogy of the magnet with the voltaic pile is perfect.

The paper concludes with some practical remarks upon the delineation of the forms of the lines of force by iron filings, and by a description of the inflexion of the lines by hemispheres of hot and cold nickel; which the author considers as the corresponding case to the action of warm and cold oxygen in the atmosphere, as applied by him in the explication of some of the phenomena of atmospheric magnetism, and especially of the annual and daily variation.

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## *Repair of a Vessel's Bottom while Afloat.* By W. Moody, Foreman of Shipwrights.*

The *Geyser*, steam sloop, has been taken into dock, and her bottom examined, as it was greatly injured by the vessel striking on the rocks at Ile Grand, about 50 miles from Janeiro. Fifty-four feet in length, and several planks in breadth, had been stove in by the accident, but her commander, by adopting a plan suggested by Mr. Moody, foreman of

* From the London Civil Engineer and Architect's Journal, January, 1852.

shipwrights at Woolwich Dockward, the *Geyser* was repaired while afloat, and brought home safe to this country, although the injuries she sustained were within a short distance of the keel.

The following, which has been issued by the Admiralty, explains the mode of repairing the damage the *Geyser* sustained on a shore where she must otherwise have been left to her fate, as the tides only rise a few feet, and the great weight of her engines would have prevented her being drawn up on shore.

"In obedience to directions to report the manner in which I proceeded to replace a defective sheet of copper on the bow of her Majesty's ship *Hyacinth*, the same being five feet below the light water-line, I beg to state, that on considering what means could be adopted for so doing, short of heaving the vessel out, it occurred to me that the principle of coffer-dam might be applied to it. I accordingly caused a water-tight case of three sides and a bottom to be made, ascertained the curve on the bow on each side of this defective part, and cut the mouth or open side of the case to fit it; and having lined or dressed the curved edges with felt, saturated with tallow, and attached ballast to the bottom, the case was suspended by a tackle to the rough tree rail, and lowered until the top was within a few inches of the surface, opposite the defective part, over which it was hauled by means of two hawsers, one placed vertically from the rough tree rail under the keel to the opposite side, the other horizontally from the quarter round to the stern to the opposite side, and both set taut with tackles. By these means the case was made to fit close to the bottom, where it was further secured by a shore, reaching from the side of the ship to its outer edge, to prevent its rising. The suction hose of a fire engine was then placed in the case, and the water contained in it pumped out. When empty, two shipwrights descended, and removed the defective copper, replacing it with a new sheet. The operation from the time of suspending the case until completed, did not occupy more than twenty minutes.

"This principle could be applied to the repairs of many defects under water, such as the wing cocks of ships, or the pipes in the bottom of steam vessels."

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## *On the Compounds of Cotton with the Alkalies.* By Dr. J. H. Gladstone.*

The author first described the process of Mr. Mercer, by which the beautiful fabrics made known to the public through the Great Exhibition are produced. When cotton, or an article made of that material, is immersed in strong caustic soda in the cold, a certain combination is effected—which is again destroyed by pure water; but the "Mercerized" cotton thus produced is permanently contracted, and rendered more susceptible of dyes. This was illustrated by a number of specimens, much shrunk, so that they assumed an appearance of extraordinary fineness, others puckered in patterns by partial Mercerization, and others again printed with colors which surpassed in depth and brilliancy the colors

* From the London Atheneum, February, 1852.

produced by the same means on the calico in its original state. Dr. Gladstone proceeded to detail experiments by which he had succeeded in obtaining the compound of cotton and soda free from adhering alkali, through the agency of strong, sometimes absolute, alcohol. He found that the proportion of soda which combined with the lignine varied with the strength of the solution employed, but under no circumstances exceeded one atom. There was a varying amount of combined water. Some properties of this compound were discussed, and the author then proceeded to state his conviction, that there was no sufficient ground for viewing the "Mercerized" cotton as chemically different from the original lignine. It is identical in composition, and the change of properties may be accounted for by the change in its physical condition. When viewed under the microscope, the fibres in their ordinary condition appear as flattened twisted ribands; but the moment they are touched by the alkaline ley, they untwist themselves, contract in length, and swell out, assuming a rounded solid form; and this circular appearance they retain after the soda is removed by water. This not only explains the shrinking, but the cause of a larger quantity of dye being absorbed as the substance of the fibre itself is porous. Potash has a similar action to that of soda.

## FRANKLIN INSTITUTE.

*Proceedings of the Stated Monthly Meeting, June* 17, 1852.

Edmund Draper, Esq., President, *Pro. Tem.*

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations were received from The Royal Astronomical Society, London; Henry Gassett, Esq., Boston, Massachusetts, and Messrs. P. A. Brown, Dr. L. Turnbull, Percival Roberts, Geo. M. Conarroe, and Dr. Charles M. Wetherill, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of May.

The Board of Managers and Standing Committees reported their minutes.

New candidate for membership in the Institute (1) was proposed, and the candidates (6) proposed at the last meeting were duly elected.

Mr. Geo. W. Smith reminded the meeting that on February 20, 1851, he had presented a list of the number of miles of railroads at that time completed in the United States, and an estimate of the number of miles that would be completed during the present year. Nearly two years having elapsed since the presentation of that estimate, he now had it in his power, from the reception of information from the whole of the United States, to test the accuracy of the predictions. The amount completed and to be completed the present year, inclusive, may be stated at 13,200 miles, including therein every description of railway, either public or private, an amount somewhat exceeding his former estimate, and derived mainly from the construction of lines not at that time in progress.

He then proceeded to give an estimate from the information that he had collected of the progress of these works during the next three years, ending at the termination of 1855; admitting, however, that the same accuracy was not as attainable as in the former estimate, inasmuch as that the period would be greater, and many contingencies which might affect the result could not be made the subject of calculation; the amount, however, he estimated at 18,900 miles at the minimum, and might attain at the maximum 19,700 miles, and even reach 20,000 miles if the bills now before Congress, in aid of Iowa and Missouri, should become law, and provided no commercial convulsion should create a stringency in the money market.

He then described the vast army of laborers on these works, and the various establishments directly or indirectly connected with them, as one of the great causes of the rise in the price of food, the others being emigration to California, the unprecedented immigration to this country from the great swarming hive of Europe, and the unprecedented increase of our urban population in a great measure attributable to this immigration, and the activity of commerce consequent thereon, and the result moreover in a great degree of these very railways, plank roads, canals, and steam navigation. The high price of provisions was thus enhanced on the one hand, and on the other prevented rising still higher by one and the same set of causes, which are likely still to continue for some time in operation. The drought of the last year and the unusual cold of the present, could but partially account for this rise.

In speaking of the density of population already attained in some parts of the United States, Mr. Smith referred to a map which he had constructed, which presented a curious illustration of this density. He traced the boundary of an area as large as the kingdom of Great Britain, as follows: commencing on the Atlantic at the mouth of the St. Croix river, ascending it to the head; from this point a line was drawn to the Saco, where it debouches from the White Mountains in New Hampshire, thence to Sandy Hill on the Hudson, in New York; thence to Oswego on Lake Ontario, including all south of it in New York, and all of New Jersey, Pennsylvania, and Maryland, north of the Blue Mountains; along this Mountain to the Potomac in Maryland, thence by the latter river to Washington, D. C., thence by a straight line to New Haven on Long Island Sound, and thence by the sea to the place of beginning in Maine. The included area will be 84,000 square miles, a close approximation to the Kingdom aforesaid, and the population of this area at the present moment, including the usual increase since the last census, is 8,180,000 in round numbers, an amount equal to that of Great Britain at the accession of George III, and about one-third of that at the present day. The present inhabitants of the American area within the boundaries just mentioned, is *twice as great* as the *average* population to the square mile in Europe, and vastly greater than the population of eastern or northern Europe, although much less, of course, in comparison, than the British, French, German, Austrian, and Italian countries, &c.

A line drawn from Massachusetts Bay to the Potomac, almost in a straight line, passes through more numerous and more populous cities than can be found on a similar line of about 400 miles in extent, drawn

on any part of the globe, with the exception of China; London must also be excepted. The population of New York, with its suburbs in Long Island, New Jersey, &c., included in a circle of twelve miles radius round the City Hall, (as the metropolis of London is in a circle of twelve miles round St. Paul's,) is at the present moment, (1852,) 860,000 people, and at the termination of 1855, which will be the period when the 20,000 miles of railway mentioned in his address to the meeting this evening, would be completed, namely, in a little more than 3½ years from the present time, New York will contain more than one million.

Mr. S. alluded to the probable results of the enormous increase of the town population of the United States on the character and institutions of the people.

The Lenticular Stereoscope, the contrivance of Sir David Brewster, with a number of binocular daguerreotype portraits and representations of statues, and still life talbotypes and diagrams, were presented to the meeting by Mr. Smith, and the phenomena of vision which they illustrated, briefly explained. Mr. Smith stated that it was scarcely necessary to remind the members of a fact with which they were already well acquainted, namely, that soon after the first publication of the Stereoscope of Dr. Wheatstone, many years ago, he had at a public meeting of the Institute, from the place where he was now standing, and before some of the audience whom he was now addressing, proposed the execution of these very binocular daguerreotypes, and subsequently, of talbotypes, and had from time to time brought the subject before them, long prior to the publication of this interesting illusion, which has been revived, and doubtless reinvented by Sir D. Brewster. Mr. S. further stated that he had for many years been endeavoring to induce some of the daguerreotypists of this City to make such portraits, and an amateur had, at his request, a number of years ago succeeded in obtaining them. The stereoscope of Sir David Brewster is certainly superior to the simple contrivance claimed by Mr. Wheatstone, whether correctly or not, he would not detain the meeting by inquiring; dissimilarities of pictures on the retina of the human eye, when the optical axes converge, enabling us to judge of the form and solidity of objects, having been most strangely claimed by Mr. Wheatstone as a discovery of his. Mr. S. proceeded to show the invalidity of such claim, by an investigation of the history of binocular vision by various writers a half a century since, and went back to the times of Leonardo Da Vinci, and even to the times of Galen, 2000 years ago, to show that this phenomenon, so perseveringly claimed by Mr. W. as a new discovery, had been observed and understood even before "the time whereof the memory of man runneth not to the contrary." A phrase has long been in use among painters, namely, when a picture wants apparent relief, it is spoken of as a picture painted by a one-eyed man. Mr. S. then briefly drew the attention of the meeting to a number of methods by which different varieties of stereoscopes might be made, and that doubtless many others could readily be devised by such as were familiar with the elementary principles of optics.

Messrs. M'Clees & Germon, to whose courtesy the meeting was indebted for the beautiful binocular pictures before them, were, he believed, the first artists in Philadelphia who had prepared them for sale.

······# JOURNAL

OF

# THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

# PROMOTION OF THE MECHANIC ARTS.

AUGUST, 1852.

## CIVIL ENGINEERING.

*On Metallic Constructions.* By W. Fairbairn, C. E., F. R. S.*

[Paper read at the Mechanics' Institution, Manchester.]

Continued from page 5.

*The Effect of Shot on Iron Vessels.*—Although at first sight alarming, they are, on more mature consideration, such as might be reasonably expected. A number of experiments were undertaken some years since at the arsenal, Woolwich, to determine the effect of shot upon the hull of an iron vessel, and also with the view of providing means for stopping the passage of water through a shot-hole near or below the water-line. The gun used in the experiment was a 32-pounder, at the distance of 30 yards from the targets, and was loaded with the full charge of 10 lbs. of powder, and a charge of 2 lbs. to produce the effect of distance, or a long shot. At these experiments I was present, and the results—some of which I may venture to mention—were exceedingly curious and interesting. The initial velocity of the ball, 6 inches diameter, with a full charge of 10 lbs. of powder, is about 1800 feet per second, and with 2 lbs. of powder about 1000 feet. In these experiments there were five or six targets, about 6 feet square, composed of different thicknesses of plates, and variously arranged so as to represent in effect as well as appearance a

* From the London Civil Engineer and Architect's Journal, May, 1852.

portion of the side of an iron ship. The engravings (fig. 1) represent a side view and section of the plates and fastenings of the targets, and (fig. 2) the effect produced by the shot as it passed through the plates, and in three or four experiments through a lining of india rubber and cork dust, which was specially introduced to absorb or receive the splinters.

Fig. 1.

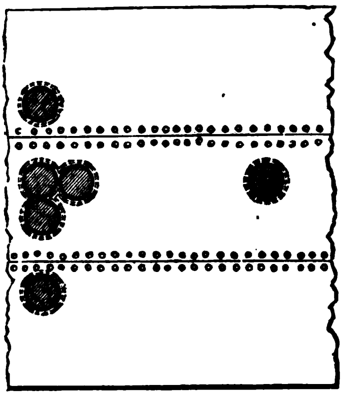
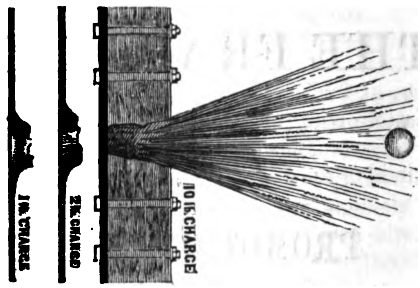


Fig. 2.




Whilst laying before you such information as I possess on the subject of iron ship-building, it is not my intention to trench upon the province of the marine architect as respects the lines, and other detail required in construction. This field is already occupied by men of superior talent, and the one that lays more immediately open before me is that which refers to the proportion of the parts, the distribution of the material, and the equalization of the powers of resistance to strain in all parts of the structure. These are considerations which, to a greater or less degree, affect almost every description of mechanical construction. If we study the laws of nature, we shall find in the endless varieties of construction in the animal and vegetable kingdoms no waste of material; that every animal and every plant is adapted to its purpose; its organization is perfect; every joint, muscle, and fibre is suited to the work it has to perform, and the utmost harmony, economy of material, and due proportion of the parts are the prominent features of the great teacher of all arts—Nature. With such examples before us, with such a wide and wonderful range of objects, why should we blunder and hesitate when we should analyze and investigate? There is no mechanism so intricate but what we find its compeer in nature, where we may find a rule for our guidance. We have, therefore, only to study the great Architect of the universe, and we need never be at a loss for examples, and, above all, close approximations to the laws which govern all constructions. As our present object is, however, to inquire into the laws which guide the experienced ship-builder in the prosecution of his art, it will be proper, in the first instance, to ascertain the nature and strength of the material he may choose to employ, in order to show the way it should be disposed to produce at a minimum cost the greatest possible effect. For these objects, I am fortunate in having before me a long series of experiments which I made for the same object more than ten years ago. They have elicited a great many facts,

of which the following is a short abstract, and which I trust may be equally beneficial in this as they have been in other constructions.

*Resistance of Wrought Iron Plates to a Tensile Strain.*—In these experiments, which were made on five different sorts of iron, the tensile strengths in tons per square inch are as follows:

| Description of Iron. | In direction of fibre. | Across the fibre. |
|---|---|---|
| Yorkshire plates, | 25·770 | 27·490 |
| Yorkshire " | 22·760 | 26·037 |
| Derbyshire " | 21·680 | 18·650 |
| Shropshire " | 22·826 | 20·000 |
| Staffordshire, | 19·563 | 21·010 |
| Mean, | 22·519 | 23·037 |

Or, as 22·5 : 23, equal to about $\frac{1}{45}$ in favor of those torn across the fibre. In following up the same investigation on timber, I found, according to Professor Barlow, of Woolwich, that the cohesive strength of different kinds of hard wood were—

| | | | |
|---|---|---|---|
| Box, | 20,000 lbs. | Beech, | 11,500 lbs. |
| Ash, | 17,000 " | Oak, | 10,000 " |
| Teak, | 15,000 " | Pear, | 9,800 " |
| Fir, | 12,000 " | Mahogany, | 8,000 " |

Assuming Mr. Barlow to be correct, and taking the main strength of iron plate, as given in the experiments, at 49,656 pounds to the square inch, or say 50,000 pounds, we have this comparison in pounds between wood and iron:

| | Timber. | | Iron. | Ratio. |
|---|---|---|---|---|
| Ash, | 17,000 | : | 50,000 | or as 1 : 2·94 |
| Teak, | 15,000 | : | 50,000 | or as 1 : 3·33 |
| Fir, | 12,000 | : | 50,000 | or as 1 : 4·16 |
| Beech, | 11,500 | : | 50,000 | or as 1 : 4·34 |
| Oak, | 10,000 | : | 50,000 | or as 1 : 5·00 |

Hence it appears that malleable iron plates are five times stronger than oak; or, in other words, their powers of resistance to a force applied to tear them asunder is as 5 to 1, making an iron plate ½-inch thick equal to an oak plank 2½ inches thick. In marine constructions, where the material is iron, our knowledge of its resisting powers would be incomplete, if we did not consider it in its union and all its bearings as regards its application to ship-building. Unlike timber, which has to be caulked between the joints, with a tendency to force them open, the iron ship is a solid mass of plates, which, if well riveted, will resist forces—such as the action of the seas—that no timber-built ship, however strong, would be able to withstand. The iron-built ship, when constructed with butt-joints, with interior covering plates, and smooth exterior surface, is superior as regards strength, buoyancy, and lightness, to any other vessel, of whatever material it may be constructed. In all these combinations it is, however, a desideratum to have the parts, the joinings, and the connexions as near as possible of equal strengths. This in practice cannot always be accomplished; but with due regard to a correct system of riveting and careful formation of the joints, a near approximation to uniform strength may be obtained. As a practical guide to these objects, I shall append a short summary of the experiment indicating the relative strengths of different forms of riveting, and in what they differ from the

strength of the plates, taking the whole as one continuous mass without joints. The results obtained from forty-seven experiments on double and single riveting are here recorded, the first column showing the breaking weight of the plates, the second the strength of single riveted joints, and the third that of double riveted joints, both of equal section to the plates, taken through the line of the rivets:

| | lbs. per sq. inch. | lbs. per sq. inch. | lbs. per sq. inch. |
|---|---|---|---|
| | 57,724 | 45,743 | 52,352 |
| | 61,579 | 36,606 | 48,821 |
| | 58,322 | 43,141 | 58,286 |
| | 50,983 | 43,515 | 54,594 |
| | 51,130 | 40,249 | 53,879 |
| | 49,281 | 44,715 | 53,879 |
| | 43,805 | 37,161 | — |
| | 47,062 | — | — |
| Mean, | 52,486 | 41,590 | 53,635 |

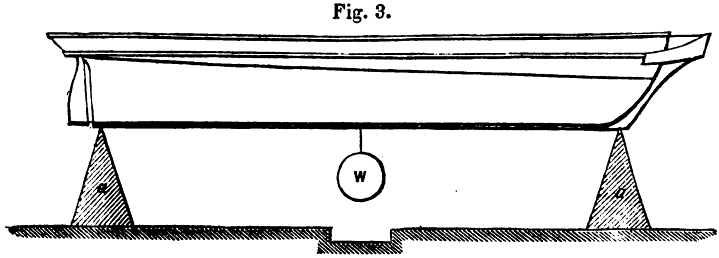
The relative strength will therefore be—for the plate, 1000; double riveted joint, 1021; single riveted joint, 791; which shows that the single riveted joints have lost one-fifth of the actual strength of the plates, whilst the double riveted joints have retained their resisting powers unimpaired. These are convincing proofs of the superior value of the double riveted joints; and in all cases where strength is required, this description of joint should never be omitted. In a previous analysis, the strengths were as 1000 : 933 and 731; but taking the mean, we have 1000 : 977 and 761 for the double and single riveted joints respectively. From these we must, however, deduct 30 per cent. for the loss of metal actually punched out for the reception of the rivets; and the absolute strength of the plates will then be to that of the riveted joints as the numbers 100, 68, and 46. In some cases, where the rivets are wider apart, the loss sustained is not so great; but in iron ships, boilers, and other vessels which require to be water-tight, and where the rivets are close to each other, the edges of the plates are weakened to that extent. Taking, however, into consideration the circumstances under which the results were obtained, as only two or three rivets came within the reach of experiment, and taking into account the additional strength which might be obtained by an increased number of rivets in combination, and the adhesion of the two surfaces of the plates in contact, we may reasonably assume the following proportions, which, after making every allowance, may be fairly considered as the relative value of wrought iron plates and their riveted joints. Taking the strength of plates at 100, we have for the double riveted joint 70, and for the single riveted joint 56; which proportions may safely be taken as the standard value of joints, such as are used in vessels required to be steam or water-tight, and exposed to a pressure varying from 10 lbs. to 100 lbs. on the square inch.

Having thus established correct data as respects the strength of materials, either singly or in combination, we shall have less difficulty in their application to the construction of vessels exposed to severe strains, such as boilers, bridges, or an iron ship; and notwithstanding the boasted declaration, that the "wooden walls of Old England" are our surest defences, we shall not, in my opinion, seriously injure, but greatly benefit our position by pinning our faith to the "iron walls of the sea-girt isle."

This, I am satisfied, will be the case if we persevere in the use of a material which must eventually supersede every other in the construction of vessels calculated to maintain the ascendency of the British marine.

*Iron Ship-Building.*—In the construction of iron ships three important considerations present themselves. First, strength and form; second, security; lastly, durability. To the first of these considerations, it will be necessary to ascertain for what purpose the vessel is to be used. Let us assume it to be one of the Atlantic, or other great ocean steamers, and we have a model both in form and tonnage, that would become equally formidable as a war steamer, or useful and commodious as a packet calculated to shorten the distance between the extreme points of a lengthened voyage. We must consider this important part of the question in all those varied forms and conditions to which vessels are subjected under strain, whether arising from a tempestuous sea, or from being stranded on a shore, under circumstances where they are not only seriously damaged, but where wooden vessels frequently go to pieces, and are entirely lost. In the former case, that of a tempest, such as a tornado under the tropics, where ships are not unfrequently much strained, we have in the iron ship, if properly constructed, greatly increased security; and provided we take the vessel in its best construction, and regard it simply as a huge hollow beam or girder, we shall then be able to apply with approximate truth the simple formula used in computing the strengths of the Britannia, and Conway, and other tubular bridges. Let us, for example, suppose a vessel of similar dimensions to the *Great Western*, (the first steamer that

Fig. 3.



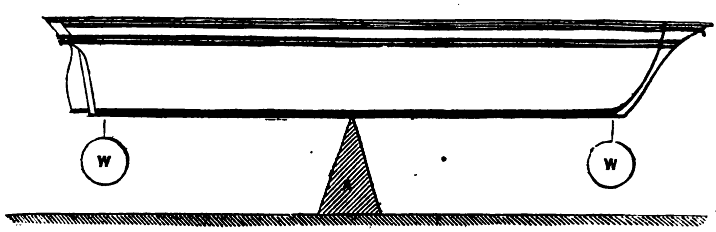




Fig. 4.

successfully crossed the Atlantic,) 212 feet long between perpendiculars, 35 feet beam, and 23 feet from the surface of the main deck to the bottom of the sheathing attached to the keel. Now, assuming a vessel of this magnitude, with its machinery and cargo, to weigh 3000 tons, including her own weight, and supposing, in the first instance, that she is suspended on two points, the bow and stern, at a distance of 210 feet, as shown in fig. 3, we should have to calculate from some formula yet to be ascer-

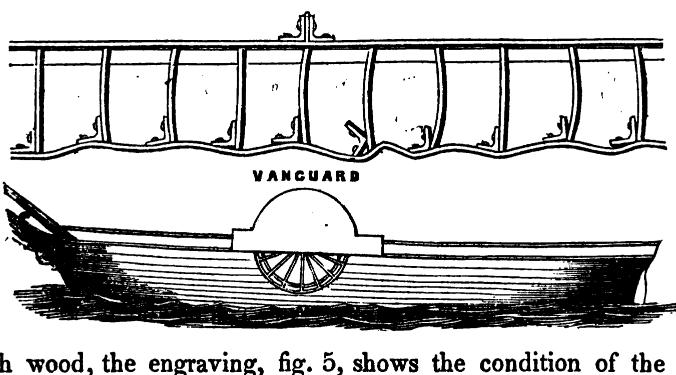
tained by experiment the correct sectional area of the plates, to prevent the tearing asunder of the bottom, and the quantity of material necessary to resist the crushing force along the line of the upper deck. These data have yet to be determined; but the iron ship-builder cannot be far wrong if he assumes the breaking weight in the middle to be equal to two-thirds of the united weight of ship and cargo. This, in the case before us, would give an ultimate power of resistance of 2000 tons in the middle, or 4000 tons equally distributed along the ship with her keel downwards. Let us now reverse the strains, and bring the vessel into a totally different position, having the same weight of cargo on board, and supported by a wave upon a single point in the middle, as shown in fig. 4. In this position, we find the strain reversed, and in place of the lower part of the hull of the ship being in a state of tension, the whole of the parts above the neutral axis are subjected to that strain; and that tension, as well as the compressive strain below, will be found to vary in degree as the ratio of the distances from the centre. In this supposed position, if we calculate the strengths—as I have been in the habit of doing, when the vessel is placed in trying circumstances, whether contending with the rolling seas of a hurricane, or the actual suspension of either portion when taking ground—we arrive at the conclusion that these calculations determine the strength, and that under any contingent circumstances we have given a wide margin, and fully determined the strength of the ship.

I am fully aware that many thousand vessels are now afloat that would not stand one-third of the tests I have taken as the minimum, but that is no reason why we should not endeavor to effect a more judicious distribution of material, and produce a maximum result, where the lives and fortunes of the public are at stake. On the question of security, we have fewer difficulties to contend with, and, so far as regards construction, I have endeavored to show, that in order to build a ship on principles as nearly perfectly secure as circumstances will admit, that she must be calculated to withstand the trials I have proposed her calculated to bear. Exclusive, however, of the simple strength of the hull, there are other considerations which require attention, such as the danger from fire, leakage, or total shipwreck.

In naval constructions we have three elements to contend with—fire, air, and water; and although we may effect in iron constructions extraordinary powers of resistance as respects the two latter, we are nevertheless subject to considerable risk as regards the former. It is true the hull of an iron ship will not burn, but the interior fittings, which are mostly of wood, if once ignited, might destroy everything on board, unless the necessary precautions are taken by iron bulkheads to cut off the communication from one division to another. From my own experience as a builder of iron vessels, I have found these bulkheads of inestimable value. They not only strengthen the ship transversely, but in case of injury to any part of the hull, any one of the divisions or compartments might be filled with water, and perhaps even the contents of that part burnt, without endangering the ship. These divisions, in fact, should be so arranged as to insure the vessel floating under circumstances of irreparable damage to any one of those parts of the ship. Again, in case of fire, under the lamentable position in which the *Amazon* was placed, it

might be advisable to have the extreme stem and stern bulkheads made double, with an air-space between them, and a valve in each to fill them with water up to the line of immersion, and thus prevent the division plates on that side clear of the fire from becoming red-hot, and igniting the timber fittings in that part which for the time might form a place of retreat. Much may be done in this way to mitigate, if not to avert, the calamitous and fatal consequences which ensue on those occasions. Bulkheads of this description, coming up to the underside of the upper deck, might obstruct to some extent the communication between decks from one compartment to another; but I believe a sufficient freedom of access from one part to another might easily be effected by well constructed iron doors, easily closed in case of accident, when they would become effectual barriers to the spread of destruction. In carrying these objects into effect, we must recur to the use of iron in every case where packet ships and steamers are employed. They apply with the same force to her Majesty's Navy, and particularly to steam frigates, and ships of war with auxiliary power. It is true, that the experiments already referred to of the dangerous effects of shot on the iron hull are alarming, but the amount of risk and destruction is always one of degree. I doubt whether the effects of shot on wooden vessels are less terrible, and undoubtedly the security gained by bulkheads and such contrivances are more than the claim to security. Besides, we are not yet satisfied that these effects are so dangerous as has been represented. On the contrary, I am of opinion that they have been greatly exaggerated, and that increased experience will ultimately show that the iron ship, under all circumstances, affords greater security, whether for war or commerce, than any other construction. As a proof of the advantages peculiar to iron as a material for shipbuilding, and the greatly increased security which it offers in comparison

Fig. 5.




with wood, the engraving, fig. 5, shows the condition of the steamer *Vanguard*, which ran foul of a reef of rocks on the west coast of Ireland, and continued beating upon them for several days with comparatively little injury. Another instance is that of the *Great Britain*, which stood the action of heavy seas beating her upon the sands and rocks of Dundrum Bay for the whole winter, and that without any serious damage to the hull.

*Durability of Iron.*—On this part of the subject, there is considerable

difference of opinion, but a very cursory view of this important question will at once show the great superiority which exists on the side of iron against timber. Although I proposed at starting to treat of metallic constructions alone, I have found it useful to add a few data, showing the strengths of different timbers which are used in combination with the metallic frameworks; and have therefore given the comparative strength of iron and the best English oak, in which it is proved that iron as a material is five times stronger than oak. This is, however, not the question which enters into the subject of durability, as the jointing of the one is incomparably superior to that of the other. In the building of ships of the line, or large merchant vessels, the keel, beams, and timbers are generally of oak or teak, made of three pieces, ingeniously contrived, and united by scarphs to each other to insure strength. The ribs or frames, which are solid and close to each other, are scarphed and jointed in the same way, and the outer sheathing, which is copper-fastened, is also attached with great care, and by crossing the vertical joints of the frames great strength is obtained. The connexion of the deck-beams to the frames by strong iron knees is another source of strength; but with all the care and ingenuity and skill bestowed upon this construction, it is far from perfect in point of strength, as the vessel, when pitching and rolling in a heavy sea, produces motion at every joint, and it not unfrequently happens that the seams open and close to an extent sufficiently obvious as to the nature of the structure and defective union of the parts. Now, in the iron ship we may venture to state, that when all the parts are soundly riveted together, there are no joints. The whole may be considered as continuous, consequently there can be no yielding, except from the elasticity of the mass to the action of the sea. The plates are the same as the planking or sheathing of timber-built ships, and these plates are riveted to strong iron ribs, varying from 12 to 15 inches asunder, and answering the same purpose as the solid framing of a teak or oak vessel. As respects the comparative merits of wood and iron vessels on the score of durability, I am of opinion that the public has entertained very erroneous views with reference especially to oxidation, which for the last twenty years has been the "rock ahead" of every iron ship. The extent of this evil has been greatly exaggerated, for there are instances of several iron vessels built twenty years ago, which are still in existence, with no sensible appearance of corrosion or decay, and what is of equal importance, without having required repairs, if we except a few coats of oil-paint, or the application of some other anti-corrosive substance, to neutralize the effects of the atmosphere upon the material. Nature, however, comes to our assistance in this as in almost every other attempt in the constructive arts, and seems to confirm the proverb that a "bright sword never rusts;" for it is with iron ships as with iron rails when in constant use, there is little if any appearance of oxidation. Taking, therefore, the whole circumstances into consideration, we may reasonably conclude that much has yet to be done in this department of the useful arts, and make no doubt that the iron ship of British origin will yet ride triumphant on every sea, as the harbinger of peace, the supporter of commerce, and the great and only security of our national defence.

If, in my attempt to elucidate a subject of such vast extent, and of such

national importance, I have been successful in conveying to your minds in plain words that knowledge which it is important we all should know, I have attained the main object of my appearance in this place.

At the conclusion of the paper, a vote of thanks to Mr. Fairbairn was proposed and seconded, which was very warmly accorded.

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*Railway Accidents; their Cause and Means of Prevention; detailing particularly the various Contrivances which are in use, and have been proposed; with the Regulations of some of the principal Lines.* By Captain M. Huish.*

The author first considered those points connected with the road, and the machinery employed upon it, from which loss of life and injury to person and property most generally arose. With regard to the road or permanent way, from which fewer accidents occurred than from any other cause, its complete effectiveness was the basis of all safety in railway traveling; and for keeping it up, constant vigilance was necessary, especially when any great and sudden change of weather took place, as then the weak points were sure to show themselves. It was a very rare occurrence for trains to run off the line; and when they did so, it was more generally due to obstructions designedly placed on the line, than to any neglect of the superintendents or the plate-layers. It was little suspected how frequent, how ingenious, and how varied the attempts had become to inflict a fearful injury by these means; and though, providentially, but comparatively trifling damage had resulted from such causes, yet it was lamentable to find that in addition to all ordinary risks, so diabolical a mode of wreaking a petty vengeance, or gratifying a mischievous disposition, had to be guarded against. Of late, the punishment for such offences had been made more severe; and it was to be hoped that this would have the effect of lessening their number. Owing to the rapid developement of the traffic, and particularly of the heavy goods traffic, on the main arterial lines of the country, increased siding accommodation had become necessary; in the case of the London and North-Western Railway alone, upwards of fifty-three miles had been laid down within the last few years, although, by multiplying points and crossings, this had, *pro tanto*, increased the liability to accident; for it might be received as an axiom, that any thing which broke the continuity of a rail tended to develope danger. As, however, there were no means of avoiding these frequent "turns out," judicious regulations combined with effective signals must be relied on, and now that facing points were reduced in number, the liability to danger had been diminished. The use of self-acting switches was attended with evils of no trifling magnitude, and many accidents had occurred from reliance on them; indeed, as a general rule, machinery to supersede personal inspection and manipulation was fraught with danger.

With respect to the rolling stock, it appeared from a return of one thousand cases of engine failures and defects within two years on the London and North-Western Railway, that burst and leaky tubes nearly

* From the London Civil Engineer and Architect's Journal, May, 1852.

doubled any other class of failure; and that these, with broken springs and broken valves, amounted to one-third of the whole number; and though they caused no direct danger to the public, yet as producing a temporary or permanent inability of the engine to carry on its train, they might be the remote cause of collision. The passenger carriage, from its perfect manufacture, presented almost complete immunity from accident, for during the last four years, out of the large stock of the London and North-Western Railway, only six wheels had failed; and though at first some annoyance and alarm had been experienced from heated axles, yet by the recent introduction of the patent axle-box, it had been much reduced. The same praise could not be bestowed on the merchandise wagon, as in no portion of the system had so little improvement been made; the fracture of axles was frequent, the mode of coupling very defective, and the want of spring buffers, or even of buffers of the same height and width, rendered the destruction of property enormous. No loss of life from fire, either from heated coke or spontaneous combustion, had occurred to a passenger train, but there had been some narrow escapes.

These and other circumstances had led many persons to suggest various contrivances for communicating between the passengers, the guard, and the engine-driver, almost all of which were identical in principle, consisting of a connecting wire or rope. This plan had been tried and failed. A more feasible and favorite one was that recommended by the Railway Commissioners, which was to continue the foot-boards, so as to form a narrow platform from end to end of the train; but a committee of railway officials had subsequently expressed their unanimous condemnation of the measure. The plan now adopted on the London and North-Western Railway was, for the guard's van, at the end of the train, to project about a foot beyond the other carriages, so that the guard looking through a window in this projection, might notice the waving of a hand or a handkerchief; this was, of course, useless at night.

All these causes, however, did not produce a tithe of the accidents which resulted from a want of attention to signals and a neglect of regulations, which of all sources of danger were the most prolific. Railway stationary signals had been greatly improved of late years, and the introduction of the lofty semaphores and the auxiliary signals really left little to be desired. Besides these, there were the hand signals, to be used by the guard in cases of stoppages between stations, and the detonating signals, to prevent collisions during a fog, which latter supplied the deficiency that had been experienced, and they were found to answer exceedingly well.

The electric telegraph had greatly facilitated working under variable circumstances, and so beneficial had its effects been, that, during the year 1851, out of 7,900,000 passengers, or nearly one-third of the population of England, who had traveled over the London and North-Western Railway, only *one* individual had met with his death, (from which casualty the author also suffered,) and this was the effect of the gravest disobedience of orders. In the six months during which the Exhibition was open, 775,000 persons were conveyed by excursion trains alone, in 24,000 extra carriages, centering in a single focus, arriving at irregular hours and

in almost unlimited numbers, from more than thirty railways, without the most trifling casualty, or even interruption to the ordinary extensive business of that line.

The author thought undue importance had been attached to the question of irregularity in the times of the trains, as an essential element of safety, for with perfect signals and a well disciplined staff, no amount of irregularity should lead to danger; but, on the contrary, it should, to a certain extent, by its very uncertainty, induce increased vigilance, and therefore greater safety. Accidents very rarely happened from foreseen circumstances, but generally from a simultaneous conjunction of several causes, and each of these was provided for as it arose. The statistics of railways, and the periodical publication of the Government returns, drew public attention very pointedly to the aggregate of accidents; but it was believed that if due regard was had to comparative results, if the accidents to steamers, or in mines, to omnibus passengers, or even to pedestrians, were as carefully recorded, that then, whether as regarded the ease and celerity of transit, or the facility of conveying numbers, the railway system, even in its present state, would be found to be incomparably safer than any other system in the previous or present history of locomotion.—*Proc. Inst. Civ. Eng., April* 27, 1852.

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## AMERICAN PATENTS.

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*List of American Patents which issued from June 8th to June 29th*, 1852, (*inclusive*,) *with Exemplifications by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

16. For an *Improvement in the Construction of Retorts for Chemical Furnaces;* John Akrill, Williamsburg, New York, June 8.

*Claim.*—"I disclaim all processes to which these retorts are applicable, and all chemical compounds and mode of working the same, which are herein described; and I disclaim all the apparatus shown herein, except as follows:

"I claim the retorts, H, formed by the arch, 7, and bed, 6, with the sides, 5, 5, and perforated with the cross flues, 10, 12, or 13, below the bed and above the arch of each retort; said retorts being formed and operating as herein set forth, and being used for any purpose for which they may be available."

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17. For *Improvements in the Manufacture of Plate and Window Glass;* Terence Clark, Pittsburg, Pennsylvania, June 8.

"My invention consists, 1st, in a new and improved combination of machinery for rolling plate glass; and, 2d, for a new and improved construction of an oven for fire-polishing the plates or sheets of glass."

*Claim.*—"Having thus described my improved mode of making window or plate glass by machinery, what I claim as my invention is, 1st, The use of hollow chilled iron rollers, in the manufacture of window and plate glass, in connexion with the mode of heating them with charcoal or other combustible placed inside.

"2d, The combination of the grooves with the strips and guides and the set screws, for the purpose of regulating the width and thickness of the sheet of glass.

"3d, The use of trucks, for carrying off the sheets of glass as they pass from the rollers as aforesaid."

"4th, The combination and arrangement herein before described, of the gates, flues, and furnace, in the construction of the polishing oven."

18. For an *Improvement in Processes for Preparing Oakum;* John A. and George Cormack, City of New York, June 8.

"The nature of our invention consists in the treatment of junk, or tarred ropes and such like materials, in an aqueous solution of sulphuric or muriatic acid, which solution or solutions imparts to the oakum manufactured from the junk new and useful qualities, not obtained by any other process heretofore known or practised."

*Claim.*—"We claim the treatment of junk, by steeping or rinsing it in acidulous liquor as described, for the purpose herein set forth."

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19. For an *Improvement in Cow Catchers;* Cook Darling, Utica, New York, June 8.

*Claim.*—"What I claim as my invention is, the wheel and the guard, connected and arranged substantially as herein described, and for the purposes described."

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20. For *Improvements in Cop Spinning Frames;* George H. Dodge, Attleborough, Massachusetts, June 8.

*Claim.*—"What I claim is, the toothed quadrant, $y$, the pinion, $x$, and its shaft, $w$, in combination with the two scroll cams, $t$, $v$, their chain, $u$, tubular shaft, $f$, and the clutch contrivance made with the spring click, $g$, and one single detent or opening, $d$, the whole being applied to the scroll shaft, L, and spur gear, M, and made to operate substantially in the manner and for the purpose as herein before stated.

"I also claim the ratchet wheel, $w^2$, the arm, $b^3$, and retaining pawl or click, $c^3$, or any mechanical equivalent therefor, in combination with the balance wheel apparatus, (viz: the arm, $x^2$, the fly wheel, $y^2$, its shaft and pinion, $a^3$,) and the spur gear, $s^2$, having a positive motion as described, the whole being for the purpose as specified.

"And in combination with the scroll shaft and its mechanism, for effecting the upward and downward movement of the ring rail, I claim the mechanism for effecting the change of the downward to the upward motion of the said rail, in an easy manner, and so as to prevent injurious strain, when the spring click, $g$, strikes into the recess, $d$, of the clutch flanch, $c$, the said mechanism consisting of the arm, $f^3$, roll, $g^3$, spring, $h^3$, tube, $i^3$, rod, $k^3$, cam, $l^3$, curved lever, $m^3$, and spring, $o^3$, or their mechanical equivalents, combined and operating together substantially as herein before described.

"I also claim the improvement of so applying or combining the thread guide G, or the guide bar or rail, $u^3$, to or with the ring rail and the frame, that the said guide or guide bar shall be movable, or made to move upwards and downwards, while the ring rail so moves, and this with a movement either equal to or in accordance with that of the ring rail, or a variable, as circumstances may require, the same being for the purpose as specified.

"And in combination with the scroll, $z$, its chain and connexions with the ring rail, I claim a compensature mechanism or apparatus, for regulating the action of the copping rail or rails on the said scroll, according to the leverage, or in other words, for providing a compensation for the difference of leverage produced by the swell, as described, the mechanism employed by me, and the combination of which I also claim, consisting of the two cams, $d^4$, $e^4$, the pullies, $i^4$, $k^4$, the chains, $l^4$, $m^4$, $n^4$, and weight, $o^4$, as applied together and to the frame, and operating substantially as specified.

"And I claim the bent arm and its projection, $k$, or other equivalent contrivance, in combination with the driving belt, shifting lever, or contrivance; the same being for the purpose as herein before set forth.

"And I also claim my improvement in the construction of the thread guide, G, the same consisting in making the opening of it straight on its rear side, substantially as seen at $q^4$, $r^4$; the same being for the purpose as herein before explained.

"And I also claim my improved or new combination of mechanism, by which a sudden or very quick rise of the copping rail is effected, in order to finish each upward movement, and this so as to wind as little yarn as possible at the nose or upper end of each conic layer composing the cop; the said combination consisting of the arm, $l^2$, upon the scroll shaft, L, the levers, $k^2$, $m^2$, the arm, $c^1$, and the rollers, $b^1$, $p^2$, as applied and operated together essentially as herein before specified."

21. For a *Smoke and Spark Deflector;* Albert Eames, Springfield, Massachusetts, June 8.

*Claim.*—"I do not wish to limit myself to the special form or position of the deflecting tubes, so long as the same end is attained by analogous means. What I claim as my invention is, the method of directing the discharge of smoke and sparks, or either, from the chimney of a locomotive, by combining therewith deflectors, substantially such as herein described, the apertures thereof being governed by a valve or shutter, substantially as specified."

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22. For an *Improvement in Machinery for Making Spoons, Forks, &c.;* Alfred Krupp, Essen, Prussia, Assignor to Thomas Prosser, City of New York, June 8, 1852; patented in England, August 26, 1846.

*Claim.*—"What I claim is, the employment, for trimming the edges and giving the ornaments to the blanks, of a pair of rollers, each of which is furnished with a cutting edge and a device engraved within the same, and a space outside of said cutters, for the reception of the waste; said rollers being so worked and applied to each other, that the cutting edges of the one comes in contact with and cuts against the cutting edges of the other.

"I do not claim simply a movable die; but what I do claim is, a movable die, located within the pattern dies, so that spoons or forks, having various crests, names, or initials thereon, may be made by the same contour or device and edge pattern."

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23. For an *Improved Process for Making Axes;* John Orelup, Assignor to Isaiah Blood, Augustus J. Goffe, and George R. Thomas, Ballston Spa, New York, June 8.

*Claim.*—"I claim the method of manufacturing axe poles by a process, of which the following are its successive steps, in combination with other, as they are applied to the metal bar, when heated and prepared for manufacture, viz:

"1st, Spreading the iron bar at four points on its edges, by strokes of a peculiar tool made for the purpose.

"2d, Forming half eyes across the bar at spaces equidistant from its centre, by strokes of a narrow and round edged hammer.

"3d, Finishing the half eyes, and making them equal and similar, on a swaging tool.

"4th, Cutting the bar partly through across its centre, and doubling together the halves of the bar, so that the half eyes shall unite in correspondence with each other, and form the eye of the axe, completing the whole ready for welding the two halves of the pole together, substantially as the process is set forth in the above specification."

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24. For an *Improvement in Reflector Lamps;* James H. Pease, Reading, Pennsylvania, June 8.

*Claim.*—"What I claim as my invention is, a reflector lamp, constructed substantially as herein set forth, with a case containing a cooling liquid, for the protection of the reflector from injury, as herein described."

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25. For an *Improvement in Wheel Cultivators;* Frederick P. Root, Sweden, New York, June 8.

*Claim.*—"Having explained my improvements in wheeled cultivators, I will here state that I am fully aware that there are other modes of raising and lowering the frame containing the teeth of cultivators in use, particularly that patented to David B. Rogers, January 16th, 1849, which consists mainly of a combination of a crank axle-tree, extending across the centre of the frame, on the ends or cranks whereof are mounted the sustaining wheels; while I acknowledge the similarity of the lifting action of the cranks of the axle-tree, to that of the pivoted segment levers used by me, and which I disclaim; yet I am not aware that Mr. Rogers is entitled to claim all means for effecting the same result, and I conceive that my improvements differ in material points from his, and which form the subject of my claims as follows:

"1st, Mounting the carriage wheels upon axles, only when said axles are made to project from pivoted segment shaped levers at each side of the frame, in the manner and for the purposes specified."

26. For *Improvements in Seed Planters;* James P. Ross, Lewisburg, Pennsylvania, June 8.

"My improvement consists in the seeding apparatus, by which the seed is conveyed in measured quantities from the hopper to the tubes, which conduct it into the teeth, and also in the mode of hoisting the teeth, by which a much larger range of motion can be given to the teeth than is practicable where levers are used; also, the mode of throwing the seeding apparatus into and out of gear; and, lastly, the measuring index for measuring the quantity of land seeded."

*Claim.*—"Having thus fully described my improvements, what I claim therein as new is, 1st, The seeding apparatus, constructed substantially in the manner and for the purposes set forth, consisting of the cup and receivers, the plate, gate, and their attachments.

"I also claim the mode of putting the cups into motion and stopping them, by shifting the pitman, as described, on to or from the eccentric, by the windlass, in the manner set forth.

"I also claim raising and holding the teeth by the employment of the apparatus for turning and holding the windlass, consisting of a crank and bevel wheels, as described, so that one man can easily raise the teeth to any desired height, and to a much greater range, than can be done by levers, or similar devices, and attach it in that position, by the revolving clutch, which meets, when at the proper height, with the crank which it fastens."

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27. For an *Improvement in Harvesters;* George H. Rugg, South Ottawa, Illinois, June 8.

"The nature of my invention consists in the peculiar arrangement of the fingers which set over the sickle, and by which the sickle, with the aid of the rivets which will be hereinafter described, is prevented from being clogged."

*Claim.*—"Having thus described the nature and operation of my invention, what I claim as new is, the curved fingers, in combination with the rivets, projections below the sickle, by which means the sickle is prevented from being clogged or bound, substantially as described."

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28. For an *Improvement in Seed Planters;* Benjamin D. Sanders, Holliday's Cove, Virginia, June 8.

"The nature of my invention consists in operating a shove rod, and thus distributing the seed, by means of a cam placed on the axle of the wheels, a greater or less vibration may be given the shove rod, by properly adjusting the cam, which is divided vertically into two parts, and having a greater or less distance between the two parts, the length of the vibration of the shove rod may be regulated, so that the grain may be distributed faster or slower, as desired."

*Claim.*—"Having thus described the nature and operation of my invention, what I claim as new is, the construction of the serpentine driving cam, E, the cam being formed of two parts, *f g*, and placed on the axle, F, the part, *f*, of the cam being fixed firmly to the axle, and the part, *g*, moving freely thereon, and secured at the desired point to the axle, by the set screw, *h*, each part of the cam being formed of a collar, having a zigzag or serpentine thread or projection upon it, the friction roller or bulb, G, at the lower end of the lever, D, fitting between the threads or projections which act against it, as the cam revolves, and give a reciprocating motion to the shove rod, C, substantially as described."

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29. For an *Improvement in Hay Rakes;* Zenas Sanders, West Windsor, Vermont, June 8.

"The nature of my invention consists in attaching the teeth of the rake to the axle-tree or head of the rake, and in attaching and adjusting the thills to the same by hinges, in order to raise the teeth from the ground, and clear the same, by rolling and turning the axle-tree or head; and also in attaching and adjusting the whipple-tree to the same."

*Claim.*—"What I claim as my invention is, the construction of the axle and rake head, with hinges connecting it with the platform, in combination with the draft strap, to raise and depress the rake teeth, in the manner and for the purpose set forth."

30. For an *Improvement in the Construction of Soap Boilers;* John R. St. John, City of New York, June 8, 1852; patented in England, June 6, 1851.

*Claim.*—"Having thus described the construction and operation of my apparatus for heating, boiling, and mixing by steam, I desire it to be understood that I do not claim to be the original inventor of the application of steam to heating, boiling, and mixing; but what I do claim as my invention is, the combination of the steam jacket, tubes, and agitating rods, for transmitting and equally diffusing heat through soaps and other similar substances, where it is difficult to keep up an uniform heat throughout the mass, substantially in the manner set forth and shown."

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31. For an *Improvement in Rat Traps;* John I. Vedder, Schenectady, New York, June 8.

"The nature of my invention consists in a novel and simple arrangement of mechanism, which is placed or arranged on the top of the trap, by means of which the rat, after he has been caught, is made, through his own weight, to reset the trap for his fellow rat, and after resetting the trap, he is precipitated into a tub or barrel filled with water, and drowned."

*Claim.*—"What I claim as my invention is, the employment of the pulley, cords, and inclined tilting passage; the whole being arranged as described, and operating in combination with the tooth, having a tilting door arranged on the top of the same, and a guard placed around the door, in the manner and for the purpose specified."

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32. For an *Improvement in Grease Cocks;* Robert M. Wade, Wadesville, Virginia, June 8.

*Claim.*—"Having described my invention, what I claim therein as new is, the inclined discharge passage, of varying area, constructed, arranged, and operating, with respect to and in combination with the hollow cylinder, and its aperture, in the manner and for the purpose herein set forth."

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33. For an *Improvement in Fastenings for Garments;* Elbridge G. Belknap, Spring Garden, Pennsylvania, June 15.

*Claim.*—"I claim the combination of the catch-plate with the plates above and below it, as shown and described. I claim the perforated bar for preventing the instrument from turning, the whole being arranged and acting substantially as set forth."

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34. For *Improved Valves, or Gates, for Oblique Float Paddle Wheels;* Jacob C. Carncross, Philadelphia, Pennsylvania, June 15.

"The nature of this invention consists in placing at the edges next each other, of the obliquely arranged paddles of the wheel, a series of radial gates, turning on journals, and having right angled wings at their axis, for keeping them closed when they pass through the water, to prevent the water being moved laterly by the oblique paddles."

*Claim.*—"Having thus fully described my invention, what I claim as new is, the series of radial winged and pivoted gates, for preventing the water acted on by the paddles being moved laterally, as they move through the water, and opening to deliver the water freely, at the proper time, arranged and operating substantially as described."

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35. For an *Improvement in Mills for Crushing Quartz;* John W. Cochran, City of New York, June 15.

*Claim.*—"Having described the manner in which I construct my machines, what I claim as my invention is, giving motion to the balls between the two plates or disks, in the manner and for the purpose substantially as above specified."

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36. For an *Improvement in Piano Fortes;* William Compton, City of New York, June 15.

*Claim.*—"I do not claim as new, metallic frames, nor bridges, neither the upbearing

of the strings, nor bringing the strings to an equal length, other than in connexion with my arrangement; what I claim is, making the perforated bridge for the upbearing of the strings, a part of the solid arched frame or plate, as described."

37. For the *Manufacture of Granular Fuel from Brushwood and Twigs;* Reuben Daniels, Woodstock, Vermont, June 15.

*Claim.*—"I claim the granular fuel produced from brushwood and twigs, by cutting the same into lengths about equal to its average diameter, as herein described, as a new manufacture."

38. For an *Improvement in Cast Iron Car Wheels;* Peter Dorsch, Schenectady, New York, June 15.

*Claim.*—"I claim the double reversed corrugations, connecting the rim and hub, formed and acting as described and shown, and the combinations of these corrugated parts with the annular cylinder, between them and the hub, as described and shown."

39. For an *Improvement in Machines for Making Cigars;* William Dawson, Huntington, Connecticut, June 15.

*Claim.*—"Having thus fully described the nature of my invention, what I claim therein as new is, the manner herein described of making cigars, viz: by combining with the cutters and followers which cut off and feed in the requisite quantity of tobacco for each cigar, the rollers for rolling up the fillers and putting on the wrappers, said rollers having the requisite arrangement of parts, so as to open to receive the material, and close to form the cigar, and again open to deliver the finished article, in the manner substantially as herein described.

"I also claim the making of the roller which feeds in the wrapper, of less diameter than the rollers which form the filler, so that the filler may move at an increased velocity over that of the wrapper, for the purpose of more evenly spreading out the wrapper, and winding it more tightly upon said fillers, substantially as herein described."

40. For a *Machine for Polishing Daguerreotype Plates;* Townsend Duryea, Williamsburg, New York, June 15.

*Claim.*—"I do not claim the platform, nor frame, neither do I claim the reciprocating bed, separately; but what I claim as new is, the horizontal reciprocating bed, operated in the manner as described, or in any other equivalent way, in combination with the frame, for the purpose as herein specified."

41. For an *Improvement in Alarm Locks;* Charles Fleischel, City of New York, June 15.

*Claim.*—"Having thus described the nature of my inventions, their construction and operation, that which I claim as new is, the combination of the slide and button, constructed for the purpose of making and breaking the connexion of the bell and hammer with the bolt, catch, latch, or fastening of the lock, substantially in the manner I have described.

"I also claim the combination of the lever with the bolt and catch, or latch of the lock, by means of which, the movement of the catch is prevented, when the bolt is projected, and the catch is drawn by the same key which has drawn the bolt, constructed and operating substantially in the manner I have described."

42. For an *Improvement in Preparing Cotton Yarn for the Manufacture of Duck, and other Coarse Fabrics;* Horatio N. Gambrill, Baltimore, Maryland, June 15.

"The nature of my invention consists in passing the yarns, either single or in warps, and which are to be used without sizing, between, over and around rollers or heated pipes, which supply moisture, heat, and friction, for the purpose of softening, removing the elasticity of the threads, and condensing it, so as not to be chafed in the weaving, and so as to give the cloth the requisite body and pliability, to be more readily sown, and prevent its shrinking or stretching afterwards."

*Claim.*—"Having thus fully described my invention, what I claim therein as new is, the process herein described, of preparing yarns for coarse cotton goods, but more particularly for cotton duck, by passing them through between moistening rollers, or otherwise wetting them, and then passing them over or around grooved or plain heated steam pipes, or rollers, for removing their elasticity, smoothing and condensing them, whilst in a state of proper tension, substantially as herein described."

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43. For an *Improvement in Organs;* Albert and George Gemunder, Springfield, Massachusetts, June 15.

*Claim.*—"What we claim as our invention is, the use of a separate air chamber for supplying wind to all the pipes of a single stop as herein described, and as opposed to the old method of having a single air chamber supply all pipes of the same note or letter in the different stops; and, finally, we claim the combination of air chambers, such as are herein described, with valves communicating with the several pipes, and operated by mechanical agencies, such as are shown in the foregoing description, explanations, and the accompanying drawings, substantially as herein described."

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44. For an *Improvement in Carriage Axles;* Kingston Goddard, Philadelphia, Pennsylvania, June 15.

"The nature of my invention consists in making the box in two or more parts, with a recess to receive and embrace a collar on the journal part of the axle, or what is essentially the same, with a projecting fillet to fit into a recess in the journal part of the axle, when this is combined with the mode of securing and holding the said box on the axle, by making its periphery conical, to fit and be drawn into the hub, or into a pipe box fitted to the hub, so that by simply securing the said box within the hub or pipe box, the axle is at the same time secured within the box."

*Claim.*—"What I claim as my invention is, making the box in two or more parts, with a recess to embrace a collar on the journal part of the axle, or the equivalent thereof, substantially as described, when this is combined with the mode of securing together the section of the said box, by fitting it within the hub or pipe box, and securing it therein by a nut which embraces the several sections, and which secures them within the hub or pipe box, substantially as specified."

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45. For an *Improvement in the Motion of the Lay in Looms;* John Goulding, Worcester, Massachusetts, June 15.

*Claim.*—"What I claim as my invention is, giving the lay of a loom one or more long beats for the shuttle to pass, or to insert a wire into the web, and as many short beats as may be necessary or desirable to strike up each thread of weft and wire, with a toggle joint, operated by a sweep or some other device, connected to or operated by a crank cam or otherwise."

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46. For an *Improvement in Derricks;* Selah Hill, Jersey City, New Jersey, and Chas. H. Dupuy, jr., Rondout, New York, June 15.

"This invention consists in placing the axis upon which the jib of a derrick, crane, or similar apparatus swings, in a position slightly deviating from the vertical, by which means, with a proper arrangement of hoisting tackle, the jib can be swung, and its swinging can be entirely controlled by the hoisting tackle, while it is raising the weight."

*Claim.*—"What we claim as our invention is, placing the axis upon which the jib swings, in a position deviating from the vertical, so as to cause the jib to have a tendency to swing in one direction, and applying the hoisting tackle, or part of the hoisting tackle, in any manner substantially as described, to the side opposite to the direction in which the jib tends to swing, so as to make the hauling on the said tackle, or part of the tackle, swing the jib in the opposite direction to that in which is its tendency to swing when left free."

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47. For an *Improvement in Preparations of Archil;* Leon Jaresson, City of New York, June 15.

*Claim.*—"Having thus fully described the nature of my invention, what I claim therein

as new is, mixing and treating lichen Rocellus with a volatile alkali, urine, and clear and fully saturated lime water, in the proportions and after the manner herein substantially set forth, for the purpose of producing a coloring matter known as archil."

48. For *Improvements in Machines for Jointing Staves;* Edwin Jenney, Middleborough, and David Rood, Boston, Assignor to Edward Jenny, Middleborough, Massachusetts, June 15.

"The object of our improvement is, to enable the cutters, or the cutter heads, to adapt themselves to the formation of the bilge or curves of the edges of a stave, as well as to joint the same, whatever may be the width of the stave submitted to them."

*Claim.*—"What we claim as our invention is as follows: in combination with each carriage or frame, we claim the clamping contrivance or mechanism, by which such carriage is held firmly in position, after being moved outwards by a stave, and while such stave is being reduced on its edges, or has the bilge formed on it, such contrivance or mechanism consisting of the movable bar, the rocker bar, the lever, connecting rod, and the clamping lever; the whole being applied to each carriage, and made to act on it as specified.

"And in combination with the lever, as applied and operated in the manner above set forth, we claim the mechanism by which the fulcrum of the lever is caused to move longitudinally, or towards the cam, for the purpose of producing the effect, equivalent to shortening the rear arm of the lever, and lengthening the front arm thereof, whereby the cutter head is made to depart further from the middle of the machine, so as to increase the curve of the bilge, or make it, as it were, with a diminished radius, such mechanism being the stationary slotted plate underneath the carriage or frame, as arranged and made to operate essentially as described.

"And in combination with the cutters, which produce the bilge curve, we claim the self-adapting planes, or plane irons, arranged in front of such cutters, and for the purpose of jointing or smoothing the edges of the bilge, as explained."

49. For an *Improvement in Saddles;* William S. Kennedy, Philadelphia, Pennsylvania, June 15.

"The nature of my improvement consists in employing, for the seat of the saddle, rattan, cane, or whalebone, or other material, substantially similar in its properties and operation, woven in the usual manner, of what is termed diagonal or chain weaving. Cane or rattan woven in this manner, has been long known and used, for forming the seats of chairs, and the manner of attaching the woven cane or rattan to the frame of the chair is also well known."

*Claim.*—"Having thus described my invention, what I claim therein as new is, the employment of woven rattan, cane, whalebone, or other similar elastic substance, in the construction of the seats of riding saddles, said seats, so constructed, being attached to and combined with the saddle-tree, in the manner and for the purposes above set forth."

50. For a *Machine for Wiring Blind Rods;* Frederick H. Moore, Ithaca, New York, June 15.

*Claim.*—"Having thus fully, clearly, and exactly described my invention, what I claim is, 1st, The combining of clenching mechanism, substantially such as herein described, with devices for feeding the rod and the wire, and piercing the former, and severing, forming, and inserting the latter, whereby I make and firmly attach blind staples in their proper positions, substantially as herein described.

"2d, I also claim the pivoted clencher, arranged and actuated substantially in the manner herein specified."

51. For an *Improvement in Hanging Mill Spindles;* Wm. H. Naracon, Auburn, New York, June 15.

"The nature of my invention consists in the use of linked sockets, for holding the upper stone upon the pivot of the spindle, and of an adjustable collar-bush, for holding the spindle to its step, constructed substantially as herein set forth."

*Claim.*—"What I claim as my invention is, the combination of the bail or balance rine, (of the usual shape,) with the cock-eye of the spindle, by means of the inverted bearing cup, whose shank presses up through, and is made fast in the centre of the said bail, and whose head is enclosed in the inverted socket, which rises above and is made fast to the top of the spindle, substantially as herein set forth."

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52. For an *Improvement in Bedstead Fastenings;* Adam S. Newhouse, Richmond Co., Georgia, June 15.

*Claim.*—"What I claim as my invention is, securing the rail to the post, by means of pin C, key D, and plate E, in the manner substantially as herein set forth."

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53. For an *Improvement in Meat Cutters;* Joseph Potts, Yocumtown, Pennsylvania, June 15.

*Claim.*—"Having thus fully described my improvements in meat cutters, what I claim therein as new is, the mode of attaching the knives herein described, by which they can be taken out and replaced expeditiously."

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54. For an *Improvement in Ore Stampers;* Thomas Keaney, Philadelphia, Pennsylvania, June 15.

"My improvement consists in adding weights above the stamper as the stamper wears away, so as to use it entirely up, or nearly so, before renewing it, which effects a great economy in the use of the stamper."

*Claim.*—"Having thus fully described my improved stamper and its mode of operation, what I claim therein as new is, the employment of weights upon the stamper, substantially as described, to keep up a uniformity of weight as the stamper wears, as herein set forth."

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55. For an *Improvement in Hand Seed Planters;* Gelston Sanford, Ellenville, New York, June 15.

*Claim.*—"Having thus described the nature and operation of my invention, what I claim as new is, the method of conveying seed from the seed box, and depositing it in the furrow or hill, substantially as herein shewn and described, viz: by having the rods attached in any proper manner to a staff, said staff rods passing vertically through the bottom of the seed box, the upper part of the rods having cups attached to them by elastic joints, the cups having spurs projecting from them, which cant or turn over the cups, when the staff and rods are raised, and throw the seed into the tops of the tubes, when they catch under the projections, the lower ends of the rods forcing out the seed from the tubes, when the staff is depressed, and the springs retaining it when the staff is raised."

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56. For an *Improvement in Harvesters;* William and Thomas Schnebly, City of New York, June 15.

*Claim.*—"1st, We claim as our invention, the arrangement of the bridges beneath the platform, in combination with chain bands, having accommodating knee formed fingers, or rakes, working on pivots and attached thereto, substantially as described.

"2d, We also claim working the vibrating cutter between an under and an upper open guard or finger, as described and represented."

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57. For an *Improvement in Label Cards;* James Sharp, Roxbury, Massachusetts, June 15.

*Claim.*—"I claim the manufacture of label cards or tickets, of cloth and paper, struck and pressed together, substantially as above described."

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58. For an *Improvement in Machines for Making Cordage;* David Perry, Assignor to F. & J. W. Slaughter, Fredericksburg, Virginia, June 15.

*Claim.*—"Having thus fully described my improved rope and cordage making machine,

what I claim therein as new is, 1st, The arrangement and combination of the parts by which the machine is enabled to stop itself, when the sliver becomes exhausted, or nearly so, in any one of the cans, viz: by means of the movable bottoms, within the cans, connected to the rods, which pass through the tubular journals of the can frames, and descend below the disk, the arm fixed near the centre of the spring shaft, and the arm fixed near the projecting end of the said shaft, and the arm projecting from the side of the machine, or the respective equivalents of the said parts, when arranged, combined, and operating with each other and with the fixed pulley, and the loose pulley on the shaft, substantially in the manner herein set forth.

"2d, I also claim the corrugating of the sides of the cans, to prevent the sliver from rising therein, when it is pressed into the same, by which a much larger quantity of sliver can be placed in them, than can be placed in cans of the usual form.

"3d, In combination with the said corrugations in the sides of the cans, I also claim the perforating of the sides of the same, for the purpose of allowing the air to escape therefrom, when the sliver is compactly pressed into the cans.

"4th, I also claim the inserting of a wing, or wings, into each of the cans, for the purpose of preventing the combined annular and rotary motion which is imparted to the cans from twisting and kinking the slivers, as they rise therein to the upper tubular journals of the can frames, substantially as set forth."

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59. For *Improvements in Sewing Machines;* Allen B. Wilson, Assignor to N. Wheeler, A. B. Wilson, Alanson Warren, and E. P. Woodruff, Watertown, Connecticut, June 15.

*Claim.*—"What I claim as my invention is, the combination of the bobbin for carrying one thread, with a rotating hook, which is of such form, or forms part of a disk, or its equivalent, of such form, as to extend the loop on the other thread, and pass it completely over the said bobbin, whereby the two threads are interlaced together; the parts being arranged and operating in any way substantially as herein set forth."

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60. For an *Improvement in Machine for Stamping Ores;* Virgil Woodcock, Swanzey, New Hampshire, June 15.

*Claim.*—"I do not claim as my invention, the combination of the drum or pulley, K, the strap, I, the frame, B, its catch lever, and the cam at the top of the gins, as employed to elevate the ram or weight, and disengage it, so as to enable it to fall down on the bed or mortar; nor do I claim the arc, $g^1$, of cogs, and the two gears, N $N^1$, (applied to their two shafts,) for the purpose of alternately imparting a rotary motion to each shaft, as I am aware that such are old contrivances; but what I do claim as my invention is, the combination and arrangement of the said arc of cogs, and its wheels, the two spur wheels, N $N^1$, the shafts thereof, the drums, K $K^1$, straps, I $I^1$, frames, H $H^1$, their catch levers, and disengaging cams; the whole being applied to the two weights or rams, and made to operate, or alternately raise them, disengage them, allow them to fall, and afterwards re-engage them, all as specified.

"And in combination with the two spur gears, N $N^1$, and the arc gear, $g^1$, P, I claim the cam, *k*, on the wheel, P, the two spring catches $i$ $i^1$, and the two pins or studs, $h$ $h^1$, all arranged, applied, and made to operate, substantially in the manner and for the purpose as herein before specified."

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61. For an *Improvement in Friction Clutch;* Wendell Wright, City of New York, June 15.

*Claim.*—"I do not claim as my invention, making a loose pulley fast with its shaft, by means of the friction of internal segments; but what I do claim as my invention is, operating the segments for producing friction on the inner surface of a loose pulley, by means of a thimble on the shaft of the pulley, connected with the segments by diagonal rods or braces, substantially as described."

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62. For an *Improvement in Detaching Harness from Horses;* George Yellott, Bel Air, Maryland, June 15.

"The nature of my invention consists in so constructing the hames and saddle-tree of

the harness as to enable the driver, at any time, by a single pull of a cord, to detach the horse from the vehicle, so that the animal, stripped of the harness, goes off with nothing but his collar, bridle, and reins attached."

*Claim.*—"What I claim as my invention is, the manner of constructing the hames, the saddle-tree, guard, and stop, as herein above described, so as to enable the driver, at any time, to detach the horse, or horses, from the harness and buggy, carriage, or other vehicle, by a single pull or jerk of a cord."

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63. For a *Machine for Washing and Amalgamating Gold, etc.;* Alexander Barclay, Newark, New Jersey, June 22.

*Claim.*—"What I claim as my invention is, the manner herein described of constructing the hollow revolving cylinder, to wit: with brackets along its periphery, and an inner partition near its discharge end, for separating, washing, and causing gold to amalgamate, in the manner herein described."

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64. For an *Improvement in Valves for Pumps;* Joel R. Bassett, Cincinnati, Ohio, June 22.

*Claim.*—"What I claim as new is, the device, consisting of a cylindrical box-valve, with its inducting openings, and its side or water way openings, and its eduction openings, and of a valve chest adapted thereto, with its induction, and side or water way, and eduction openings, corresponding to the openings in the valve box; the whole, in connexion with the usual water ways and barrel of a double acting pump, furnishing the parts necessary to the operation of such a pump; thus obtaining from a single valve, deriving its motion from the out-flowing and in-flowing currents, the result for which several separate valves have hitherto been needed, substantially in the manner described."

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65. For an *Improvement in Bomb-Lance for Killing Whales;* Christopher C. Brand, Ledyard, Connecticut, June 22.

*Claim.*—"What I claim as my invention is, the mode of sustaining the fuse rope in the fuse tube, and preventing the fire of the charge of the gun from passing by the fuse rope and into the bomb, viz: by the two metallic tubular plugs, cast around the ends of the fuse rope and into the fuse tube, and arranged substantially as specified.

"I do not claim the application of wings or feathers, to a shaft or rod, to direct its passage through the air; but what I do claim is, my improved mode of making them, viz: of vulcanized india rubber, or other equivalent, so that they may not only resist the destructive powers of the explosion, but be folded down on the shank, when put into a gun barrel, and have the property of elasticity, such as will enable them to unfold themselves after being discharged from the gun."

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66. For an *Improvement in Heat Radiator;* Merrill Colvin, Rochester, New York, June 22.

*Claim.*—"Having described the construction and operation of my heat radiator, what I claim as my invention is, the combination of the flue, I I, the cylindrical flue, the flue H, the receiver, G, the pipes, L L, and the open space, P; all operating in the manner and for the purpose as herein described and set forth."

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67. For an *Improvement in Horse Powers;* Aaron D. Crane, Newark, New Jersey, June 22.

*Claim.*—"What I claim as my invention is, 1st, The method of combining and arranging the two pallets as constructed, by a joint with the levers in such a manner, that by the action of the teeth of the main wheel against the end of these pallets, an oscillating motion is given to the levers; and by such motion, and the aid of the connecting rods and cranks, a rotary motion is produced; but I do not claim the application of connecting rods and cranks, for producing such rotary motion.

"2d, I do also claim the method of combining and arranging with the parts above claimed, the three eccentric wheels, running together in such a manner, that while the motion of the middle one is uniform, that of the other two on which the cranks act, is

irregular alternately; that irregularity being required, for the purpose of giving to the middle eccentric wheel a direct motion, not subject to being reversed, as it would be by using common wheels; all as herein before described for the purposes set forth.

"3d, I do not intend, by the foregoing claim, to limit myself to the application of this invention to horse powers, but to apply it as I may think proper, to other purposes, for driving machinery, when speed is required."

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68. For an *Improvement in Dumping Wagon;* Abm. V. Cross, Washington, District of Columbia, June 22.

"The nature of my invention consists in so arranging a wagon as to adapt it to the ordinary purposes of road use, and by a mechanical device, enable the person having it in charge to readily discharge the load by dumping; the body, by its own weight, causing it to sink on an adjustable lever or inclined plane, simply arranged, and not liable to the objections and difficulties of complex contrivances."

*Claim.*—"What I claim as my invention is, the arrangement of the adjustable bar, or incline, and screw, in combination with the rollers, all operating in the manner substantially as shown and set forth in the foregoing specification and accompanying drawings."

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69. For *Improved Wrought Nail Machinery;* Daniel Dodge, Keeseville, New York, June 22.

"My invention is such a combination and arrangement of the cutter, gripers, and hammers, that when a rod of suitable dimensions is introduced into the machine, a piece of sufficient length to form a nail will be cut off, caught into gripers, and passed under a series of hammers, receiving one stroke from each, as it progresses, and revolving during its transition, from one hammer to another, so that its different sides may be acted on alternately, until it has passed the entire series and is reduced to the requisite size and form, after which it is discharged."

*Claim.*—"Having thus described the nature of my invention, what I claim as new, is as follows: 1st, I claim the combination of a series of hammer faces with gripers, having both a rotary and progressive motion, and so arranged as to convey the blank between the several pairs of faces successively, at the same time revolving it so as to present different sides successively to the action of the hammers.

"2d, I claim such an arrangement of the several hammer faces, which act successively upon the blank, with regard to the distance of the lines in which they respectively move from the line in which the gripers move, that when the gripers move forward in said line, thereby conveying the blank from one pair of faces to another, the successive strokes which it receives, will fall on different points, thereby reducing different parts of it, successively, to the required size.

"3d, I claim, in combination with such an arrangement of the faces, with respect to the gripers, such a graduation, in the nearness with which the several pairs respectively approach, when they strike, that the several parts of the blank, upon which they respectively act, will be reduced to different sizes, and that the combined effect of the whole will be to reduce the nail to the proper form.

"4th, I claim the combination of the two kinds of faces, broad and narrow, with gripers so arranged as to present the blank to the action of the narrow ones, until it is suitably elongated, and subsequently to that of the broad ones, to receive a finish.

"5th, I claim the arrangement of a set of gripers upon the interior of a circular hub or frame, in combination with hammers placed in or near the centre of the circle in which they are arranged.

"6th, I claim adjusting the gripers, by means of a spring, or its equivalent, so arranged as to press them towards the hammers to their proper place, allowing them to recede as far as the lengthening of the nail requires, while the hammers are acting, and causing them to return again when the hammers are withdrawn.

"7th, I claim such a combination of stops for limiting the approach of the hammers to each other, with cams, or their equivalents, for forcing them together, as to diminish the inequality which unequal resistance between the faces, has a tendency to cause the springing of the parts which produce the stroke, thereby rendering the effect of the strokes uniform."

70. For an *Improvement in Sewing Machines;* Wm. O. Grover, Boston, and Wm. E. Baker, Roxbury, Massachusetts, June 22.

*Claim.*—"Having thus described our improved sewing machine, what we claim as our invention is, the arrangement above described, in a sewing machine, for feeding the cloth along, consisting of a notched bar, which has a vertical or up and down motion, for fastening the cloth upon, and releasing it from the notches of said bar, by striking it against a yielding plate, and a lateral motion, or motion forward and back, for feeding the cloth along after each stitch, substantially as above set forth.

"We also claim a circular, instead of a straight, horizontal needle, for spreading the loop of the thread of the vertical needle, substantially as above described."

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71. For an *Improvement in Foot Car;* Nehemiah Hodge, North Adams, Massachusetts, June 22.

*Claim.*—"Having thus fully described my invention, what I claim in the construction of foot cars as new is, suspending each of the treddles upon which the passenger operates from the same side of the axle, the treddles being so arranged as to rotate the axle, whether they be applied both together, or one at a time, alternately, and through said axle, give motion to the driving wheels, substantially as herein described.

"I also claim combining with the axle and driving wheels, the fixed ratchets and spring pawls, for the purpose of giving the driving wheels a continuous motion in one direction, whilst the axle may have an intermittent motion in the same direction, as herein represented and described."

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72. For an *Improvement in Clover Harvesters;* John Krauser, Reading, Pennsylvania, June 22.

*Claim.*—"What I claim as of my invention is, the hinged board, in combination with the movable cutter frame and the platform, as herein set forth.

"2d, I claim the shield, the same being constructed, applied, and operated in the manner and for the purposes herein set forth and described.

"3d, I claim the combination of the lever, *f*, and lever, *n*, the latter being constructed at its posterior end, with slot and pivot pin, to admit of antero-posterior movement, and at its anterior end, with supports for cogged gearing, so that while the levers raise and depress the cutters, they also contribute to connect and sustain the gearing for driving the cutting reel."

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73. For an *Improvement in Divided Railroad Car Axles;* Wm. S. Loughborough, Victor, New York, June 22.

*Claim.*—"I do not claim surrounding a divided axle with a tube; neither do I claim making semi-axles of a conical form; but what I do claim as my invention is, the conical semi-axle, in combination with the tube, constructed as described, for the double purpose of giving the greatest strength to the axle itself with a given weight of metal, and of increasing the strength of the tube in the centre, without a corresponding increase of the external diameter thereof.

"Again, I do not claim a hollow divided tube, attached rigidly to the wheels and revolving upon an undivided axle, to which it is secured by flanches, wings, and bolts; but what I do claim is, the peculiar manner of coupling the wheels and semi-axles to the hollow tube surrounding said axles, by the use of the groove in the hub of the wheel into which the flanch of the tube enters, in combination with the wing secured to the wheel by bolts as described, for the threefold purpose, first, of enabling the wheel and semi-axle to revolve, independent of the tube, and of strengthening the axle at its weakest point where it enters the wheel; and lastly, to prevent the end of the tube from splitting out, by thus removing half the strain from the lower to the upper side, in the manner above set forth."

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74. For an *Improvement in Steps and Bearings in Mill Spindles;* Theodore S. Minniss, Meadville, Pennsylvania, June 22.

"My invention consists in sustaining and upbearing the gudgeons of shafts for mill spindles and other revolving bodies, upon, or by the pressure of fluids, in such a manner that the friction is vastly diminished, as hereinafter more fully described."

*Claim.*—"Having thus fully described my invention, I would observe that I do not claim upbearing or sustaining the gudgeons of shafts, or other revolving bodies, by liquids, when packing and force pumps are used, for giving the desired pressure, to sustain the weight of said shaft, or other body, and to prevent the lubricating liquid from overflowing; but what I do claim as new is, lessening the friction of mill spindles and other heavy revolving bodies, by upbearing and sustaining the gudgeon of the same upon any lubricating liquid, by the use of the hollow lighter, or case, *b*, with the case, *a*, for containing said liquid, upon which said lighter revolves, or their equivalents; said lighter being proportioned to the weight it is designed to sustain, and arranged and connected with the shaft, as described, or in any other manner substantially the same in principle, operation, and effect."

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75. For an *Improvement in Planing Machines;* Nicholas G. Norcross, Lowell, Massachusetts, June 22.

*Claim.*—"I do not claim as my invention, the combination of one or more stationary planes, so arranged, that while one or more remove the rough surface of a board, the rest or last shall finish or producee on it a smooth plane surface; but I claim, when placed so as to operate on one side of a board, a cylindrical, rotary cutter, for roughing and reducing, which cuts from the unplaned to the planed surface, in combination with a stationary cutter, placed behind, and as near thereto as may be, for finishing without pressure rollers or pressure bars of any kind, whereby I am enabled to operate with greatly diminished power, and the rotary cutter will cut up and throw off the shavings from the stationary cutter, and the boards will be reduced to an equal thickness and a smooth surface."

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76. For an *Improvement in Machines for Preparing Flocks;* John R. Peters, City of New York, June 22.

*Claim.*—"What I claim as of my invention is, 1st, the construction and arrangement of the fan wheel, and its combination with the elastic grinding bed or grater, constructed as described, or in any other manner substantially the same, for effecting the feeding, separating and discharging of the flocks and other matters mixed therewith, in the manner described.

"2d, I claim supporting or attaching the concave grater or grinding bed to the frame by springs, or other elastic material, for the purpose set forth.

"3d, I claim the reflectors and their arrangement in the machine, in the manner and for the purpose set forth; the whole being combined and operating substantially as described herein."

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77. For *Improvements in Fluid Metres, &c.;* William H. Lindsay, City of New York, June 22.

*Claim.*—"What I claim as my invention is, in combination with a force pump and a piston, or plunger, actuated by water or other fluid, forced from the same, the air vessel and the drop valve arranged and actuated substantially as described, whereby the measuring piston or plunger is caused to pause at the end of each stroke, in either direction, substantially in the manner and for the purposes described.

"I also claim supplying the pump chamber and the metre chamber, through valves, arranged and operating as described, and loaded in proper relative proportions, or supplied from heads of proper proportional height, for the purpose herein described, height of head of supply, or amount of load on the valves, being equivalents, producing the same results.

"I also claim actuating the counter through the agency of a rack and a segment cog, arranged substantially as described, whereby any movement of the metre piston or plunger, less than a whole stroke, is counted up in proper proportion by the counter."

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78. For an *Improvement in Ploughs;* David Swartz, Thomas Brook, Virginia, June 22.

*Claim.*—"Having thus fully described and represented my improved plough, what I claim therein as new is, combining a plough and harrow in one implement; that is to say, attaching a comb, or rake, or its equivalent, to the rear and upper end of the mould board, to comb out and pulverize the soil on the bottom of the furrow as it is turned up, substantially as set forth."

79. For an *Improvement in Time Pieces;* S. R. Wilmot, New Haven, Connecticut, June 22.

"The nature of my invention consists in connecting the corners or pillars of the clock-frame, to the sides or thickest parts of the case, thereby forming the junction of the said frame and case, at or between their most solid parts; and my invention further consists in supplying india rubber, or its equivalent, so as to interrupt all communication of solid matter between the clock and its case."

*Claim.*—"What I claim as my invention is, insulating or separating the clock frame, from all contact with the case, by intermediate packings of india rubber, or other non-conductor of sound, substantially as shewn and set forth."

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80. For an *Improvement in Imitation of Stone;* Charles Iles, Birmingham, England, June 15, 1852; patented in England, April 26, 1849.

*Claim.*—"Having thus described the nature of my invention, and the manner of performing the same, I would have it understood that I do not confine myself to the details as herein described, so long as the peculiar character of either part of my invention be retained; but what I do claim is, the production of ornamental surfaces on picture frames, inkstands, and other articles, and on walls, and other places, and on different matters, by applying thereto colored silk, waste, or other colored fibrous substances, combined with cement, in such manner that the colored silk, waste, or other colored fibrous matter used, shall produce a veined, or marbled character."

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81. For an *Improvement in Mill Stone Dress;* Wilson Ager, Rohrsburg, Pennsylvania, June 29.

*Claim.*—"Having thus fully described the nature of my invention, I wish it to be understood, that I do not claim the polishing of one stone by rubbing it with another of the same material; neither do I claim polishing the face of mill stones by rubbing it with another stone; as both these have been essayed. But what I do claim as my invention is, 1st, the rounding off of what is usually termed the feathered edge of mill stones for grinding buckwheat, so as to present a round, smooth surface, instead of a cutting edge, as herein set forth; and this I claim, whether said furrows are polished, sharpened, or straightened, by rubbing the same with a burr-block after said furrows have been roughed out with a pick or other tool, or by any other means substantially the same."

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82. For an *Improvement in Hulling Buckwheat;* Wilson Ager, Rohrsburg, Pennsylvania, June 29.

*Claim.*—"Having thus fully described my invention, what I claim therein as new is, the method herein described of scouring or hulling buckwheat, by passing it through between horizontal stones, the runner having furrows on its face, drafted substantially as herein represented, and cut in the direction of the motion of the stone, with the design of keeping the grain from leaving the stone too fast, and for rotating them both on their short and long diameters, and the bed stone left without furrows, in the manner and for the purpose herein set forth."

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83. For an *Improved Sail Hank;* Samuel Barker, City of New York, June 29.

*Claim.*—"Having described the nature of my invention, what I claim is, the construction of a divided hank, so formed that one part may embrace the stay, and the other part enter the eyelet of the sail, and the parts be connected together by the socket, or one receiving the shank of the other, and be confined by the bolt, for the purpose of securing sails to the stay, substantially in the manner set forth and shown."

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84. For *Apparatus for Propelling Vessels;* Matthew A. Crooker, City of New York, June 29.

"The principle aimed at by me in this invention is, to produce a movement somewhat in imitation of that employed in nature by aquatic birds for their propulsion, as ducks, geese, &c.; in place of the contraction of the paddle, to represent the movement of the

foot, the former is lifted from the water, but the act of propelling is sought to be the same."

*Claim.*—"What I claim as my invention is, the combination of the radius bars, upright levers, cranks, horizontal levers, carrying paddles, and curved slots, arranged with respect to each other, and connected and operating substantially in the manner set forth herein."

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85. For an *Improved Revolving Last Holder;* Henry C. De Witt, Napanock, New York, June 29.

*Claim.*—"What I claim as my invention is, 1st, The revolving stock, constructed, and arranged, and operating in the manner substantially as and for the purpose herein set forth.

"2d, The revolving last holder, attached to the revolving stock, and having an adjustable rest or arm; the whole being constructed, arranged, and operating in the manner substantially as and for the purpose herein specified."

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86. For an *Improvement in Railroad Car Trucks;* Caleb R. Disbrow, Bath, New York, June 29.

*Claim.*—"Having described the nature of my improved safety truck for railroads, what I claim is, the construction of a truck with independent wheel frames, strengthened by braces, and connected to the opposite side wheel frame, by the bar extending across the truck, upon which said wheel frames may vibrate, substantially in the manner and for the purposes set forth and shown."

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87. For an *Improvement in Potato Diggers and Stone Gatherers;* John T. Foster, City of New York, June 29.

*Claim.*—"Having now set forth the nature of my invention, what I claim is, the use of the roller, having a series of rows of pins in its periphery, and secured on an axle-tree of a cart or other moving apparatus, in combination with an adjustable apron having teeth in it, and a discharging plate having teeth in it, substantially for the purpose of gathering stone, potatoes, fruit, or other substances or articles, and depositing them in a box, as herein before set forth."

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88. For an *Improved Lock;* Francis Garachon, City of New York, June 29.

"The nature of my invention consists in the arrangement of the lock, a check lever and its accessories, for latching and unlatching the bolt, relatively to a check lever for locking the revolving plate, whereby the auxiliary key acts upon the former by being lifted endwise, and upon the latter by its bit, when revolving in the usual manner."

*Claim.*—"What I claim is, the arrangement of the lever and its accessories, for latching and unlatching the bolt, relative to the lever, or locking the revolving key-plate, whereby the auxiliary key acts upon the former by being lifted endwise, and upon the latter by its bit, when revolving in the usual manner, substantially as set forth."

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89. For an *Improvement in Hanging Steps of Mill Spindles;* Gideon Hotchkiss, Windsor, New York, June 29.

*Claim.*—"Having thus fully described my tram-block and bridge-tree, what I claim as my invention is, the manner of connecting the tram-block foundation with the stone bearers, by means of stanchions and screw-bolts, as specified, in combination with the method of suspending the lighter lever from the shell which guides and sustains the pot, containing the step of the spindle, by means of the shell, the sway bar, and the knife edges of the sway bar and pot, or their equivalents, in manner and for the purposes substantially as described."

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90. For an *Improvement in Bedstead Fastenings;* Jasper Johnson, Genesee, New York, June 29.

*Claim.*—"I do not claim a bedstead fastening composed of a stub bolt, drawn tight on an inclined plane, as that is well known; but what I do claim is, the combination of the

fastening, composed of the stub bolt and the inclined plane, or their equivalents, drawn tight by the cording of the bedstead, with the endless screw, acting upon the inclined plane by means of cogs or other equivalent device, in order, by turning the inclined plane under the bolt, to loosen, separate, or tighten again the fastening, without the necessity of slacking the cording."

91. For *Improvements in Moulding Hollow Ware, &c.;* James J. Johnston, Cincinnati, Ohio, June 29.

*Claim.*—"What I claim as new is, the method of moulding hollow ware, or other similar castings, with a flaring rim or its equivalent, (such as the lip on cannon stove or other tubular castings,) by using third patterns, attached to suitable match plates or follow boards, and so devised that, in connexion with the first and second patterns which form the exterior, I mould therefrom the top edge, a portion of the interior of the desired casting, and a true seat for the core, thus, with the core, forming the entire mould, substantially as described and represented."

92. For an *Improved Method of Heating Sheet Iron while in the Process of Manufacture;* Henry M'Carty, Pittsburg, Pennsylvania, June 29.

*Claim.*—"Having described my improvement in the manufacture of sheet iron, by which it is made to resemble the imported Russia sheet iron, and possess that beautiful mottled gloss and smooth hard surface, what I claim as new and of my invention is, heating the sheets of iron in a bath of hot lead, instead of heating them in an oven, by which the surfaces of the sheets are protected from the oxygen in the atmosphere, during the heating process, preparatory to the rolling operation."

93. For an *Improved Compound Anchor;* Samuel Nye Miller, Roxbury, Massachusetts, June 29.

*Claim.*—"What I claim as my invention is, the above described anchor for holding ships."

94. For an *Improvement in Mixing Mortar;* Jesse Peck, Buffalo, New York, June 29.

*Claim.*—"What I claim as my invention is, the mixing of lime and sand together, before straining, substantially in the manner and for the purpose herein set forth."

95. For an *Improvement in Locomotive Engines;* Henry R. Remsen and P. M. Hutton, Troy, New York, June 29.

"This invention relates to the employment of a locomotive engine, of three cylinders, whose cranks are arranged at angles to each other of about 120°, with valves, valve chests, steam and escape pipes, so arranged as only to admit steam to one side of the pistons when the locomotive is advancing, and the other side when it is backing, the reversal being accomplished by such change of the operation of the steam, without recourse to any of the ordinary means of reversal."

*Claim.*—"What we claim as our invention is, the combination in a locomotive engine, of three cylinders, whose cranks are at angles of about 120° to each other, with valves, valve chests, escape pipes, and steam pipes, provided with throttle valves, substantially such as are herein described, whereby the steam acts only on one side of the pistons when the locomotive is advancing, and upon the other when it is backing, and the reversal is accomplished by such change in the operation of the steam, without recourse to any of the ordinary means of reversal."

96. For an *Improvement in Skates;* Nathaniel C. Sanford, Meriden, Connecticut, June 29.

"The nature of my invention consists in a peculiar manner of forming the runner, viz. out of a plate of steel, tapered at one end, said plate, by means of a die or any other proper mode, being struck or thrown into the required form."

*Claim.*—"Having thus described my invention, what I claim as new is, making the

runner out of a plate of steel, and of the form substantially as shown and specified, the plate being turned or struck the desired form by means of disks, or in any other desirable way."

97. For an *Improved Belt Clasp;* Albert M. Smith, Rochester, New York, June 29.

*Claim.*—"What I claim as my invention is, the making clasps to fasten belts or bands together, to run on machinery or around pullies, by using jaws or plates of metal, constructing and adapting them to that purpose, and then confining them together with screws, so as to hold the belts solid, and thereby introducing a new and useful manner of fastening machine belts together."

98. For an *Improvement in Method of Ringing Bells;* Thomas V. Stran, New Albany, Indiana, June 29.

*Claim.*—"What I claim as my invention is, the combination and arrangement of the levers and the compound levers, so connected and attached to the axle as to give motion to the bell clapper, in the manner and for the purposes herein shown and set forth."

99. For an *Improvement in Brick Machines;* R. A. Ver Valen, Haverstraw, New York, June 29.

*Claim.*—"I do not claim the plunger or follower, operated by a connecting rod or crank, as that is well known; but what I claim as new is, 1st, The employment or use of the lever H, having step projections, $b^1$ $b^2$, on one of its sides, attached to the connecting rod, C, and arranged as shown and described, by which a greater or less pressure of the plunger or follower upon the clay in the moulds is obtained, as desired.

"2d, I claim the arrangement of the levers, I, J, N, rods, K, L, vertical lever, M, and the rod, O, with the levers, P, S, and upright shaft, R, for the purpose of operating the feeder, T, and vibrating bar, U, substantially as set forth.

"3d, I claim the employment or use of the spring, Y, attached to the vertical lever, M, and operated upon by the rods, *r*, *r*, attached to the lever, whereby the working of the machine is prevented by any obstruction, as described.

"4th, I claim the attaching together of the feeder, T, and vibrating bar, U, the vibrating bar having a guide rod, *m*, working in suitable bearings, *n*, *n*, or arranged in any other suitable way."

100. For an *Improvement in Sofa Bedsteads;* Alfred Walker, New Haven, Connecticut, June 29.

*Claim.*—"What I claim as my invention is, the manner of guiding the seat when it is raised and lowered, and of connecting the seat and bed when extended, by means of the metallic bearings, and the grooves which they traverse, when the seat is raised and lowered."

101. For an *Improvement in Railroad Cars;* Charles Waterbury, Bridgeport, Connecticut, June 29.

"The nature of my invention consists in constructing the ends of railroad cars in such a manner, that an enclosed communication may be had from one car to the other, so as to protect the lives of passengers while passing from one car to the other."

*Claim.*—"What I claim as my invention is, an enclosed passage or communication from one car to the other, as herein described, for the purpose of ventilating the train through the ends of the cars, from the forward part of the train, and for the safety of the passengers, while passing from one car to the other, and for the purpose of keeping dust out of the cars, when the train is in motion."

102. For an *Improvement in Connecting Cocks with Pipes;* Daniel A. Webster, City of New York, dated June 29, 1852; ante-dated December 29, 1851.

*Claim.*—"Having thus fully described my invention, what I claim therein as new is, the manner herein described of making a tight joint, viz: by boring the hole in the pipe as

nearly cylindrical as may be, and making that part of the cock which is to be inserted, near the end and near the shoulder, of equal diameter with the holes, and the central part slightly larger, and then driving the cock into its place—the edges of the hole shaving the cock to its proper size and form.

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103. For an *Improvement in Sugar Boiling Apparatus;* Juan Ramos, Island of Porto Rico, Assignor to James C. Gallagher, Philadelphia, Pennsylvania, and William F. Tirado, Ponce, Island of Porto Rico, June 29; patented in Spain, April 29, 1851.

*Claim.*—"What I claim as my own invention and discovery is, the construction of the transverse canal, in combination with the hinged cover, for the double purpose of returning the froth to the receiving pans, and for preventing the syrup from falling into the canal, while being laded from one pan to the other.

"I also claim the construction of the lower longitudinal canal, with its hinged board, for the purpose of more effectually removing the feculencies, as described.

"I also claim the use of the movable plank in the coolers, which when removed, leaves a vacancy or channel for the molasses to flow away to the discharge aperture, through the bottom of the cooler."

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104. For an *Improvement in Processes for the Manufacture of Sugar;* Juan Ramos, Island of Porto Rico, Assignor to James C. Gallagher, Philadelphia, Pennsylvania, and William F. Tirado, Ponce, Island of Porto Rico, June 29; patented in Spain, April 29, 1851.

*Claim.*—"What I claim as my own invention and discovery is, the use of the juice of the plaintain stalk and quicklime combined, substantially in the manner and for the purpose described, for defecating the cane juice.

"I also claim the application of a fresh strike of concentrated syrup from the battery to the molasses first drained off, for the purpose of crystalizing the sugar yet remaining in the molasses."

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105. For an *Improvement in Revolving Boot Heels;* Thomas Walker, Birmingham, England, Assignor to Benjamin B. Thayer, Quincy, Assignor to Wm. W. Churchill, Boston, and John Baxter, Quincy, Massachusetts, June 29; patented in England, July 1, 1849.

*Claim.*—"What I claim as my invention is, the combination of the four separate pieces, that is to say, the metallic ring, the leather or flexible disk, the leather annulus or ring, and the leather disk, the said combination being represented in fig. 1, and constructed, arranged, and made to operate together, substantially as herein before described."

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### Re-issues for June, 1852.

1. For an *Improvement in the Machine for Cutting Paper and Trimming Books;* Frederick J. Austin, City of New York; dated June16, 1841; ante-dated December 16, 1840; re-issued June 22, 1852.

*Claim.*—"What I claim as my invention is, the use of a knife having a lateral or end vibratory motion, for the purpose of cutting the edges of books, paper, &c., and its combination with the frame and rods, or either of them, and operated by cams or other equivalent devices, to give a drawing and vibratory cutting action to the knife, substantially as set forth.

"I claim also the mechanical construction of the press, as arranged and combined with the parts for cutting and pressing, thereby forming an entire machine for the purpose described."

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2. For an *Improvement in Batting of Cotton, or other Fibrous Material;* Hamilton B. Lawton and Hiram T. Lawton, Troy, New York; patented March 13, 1849; re-issued June 22, 1852.

*Claim.*—"We do not claim as our invention the mode of operating a series of carding

machines to make batting, as shown by J. Essex's drawings, nor any part of the above described machine. What we do claim as our invention and discovery is, the method of making batting or wadding by laying on and covering both the upper and lower surfaces of a sheet or sheets of cotton, wool, hair, or other elastic fibrous material, that has been merely well picked, cleaned, and spread, with layers of carded, condensed, and compact fibres, such as cotton, wool, hemp, &c., for the purpose of rendering the same smooth, strong, and more suitable for bedding, wadding, and upholstery uses."

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DESIGNS FOR JUNE, 1852.

1. For a *Design for a Portabls Grate;* David Thomson, Boston, Massachusetts, Assignor to New Market Iron Foundry, of Boston, June 8.

*Claim.*—"What I claim as my production is, the new design, consisting of the sunken panels, leaf scrolls, and ornamental mouldings, herein above described and represented in the drawings, for the front of a portable grate."

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2. For a *Design for a Parlor Stove;* Samuel D. Vose, Albany, New York, June 22.

*Claim.*—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the combination of the several mouldings and ornaments as arranged together, the whole forming an ornamental design for a parlor stove, as herein set forth and described."

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3. For a *Design for a Coal Stove;* Samuel D. Vose, Albany, New York, June 22.

*Claim.*—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the combination of the several mouldings and ornaments as arranged together, the whole forming an ornamental design for a coal burner stove, as herein set forth and described."

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4. For a *Design for a Box Stove;* Samuel D. Vose, Albany, New York, June 22.

*Claim.*—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the combination of the several mouldings and ornaments as arranged, the whole forming an ornamental design for a box stove, as herein set forth and described."

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5. For a *Design for a Parlor Cook Stove;* Samuel D. Vose, Albany New York, June 22.

*Claim.*—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the combination of the several mouldings and ornaments as arranged together, the whole forming an ornamental design for a parlor cook stove, as herein set forth and described."

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6. For a *Design for a Dining Room Stove;* William L. Sanderson, Troy, Assignor to R. Finch, Sr., and Reuben Finch, Jr., Peekskill, New York, June 22.

*Claim.*—"What I claim as my invention is, the ornamental form, design, and configuration, as herein described and represented, of the stove as a whole, and also of the several plates, the feet, and vase, separately."

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7. For a *Design for a Cooking Stove;* S. W. Gibbs, Albany, New York, Assignor to North, Harrison & Chase, Philadelphia, Pennsylvania, June 22.

*Claim.*—"What I claim as my invention is, the design and configuration of the ornaments and mouldings herein described, constituting a design for a cooking stove."

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8. For a *Design for a Cooking Stove;* James H. Conklin, Assignor to R. Finch, Sr., and Reuben Finch, Jr., Peekskill, New York, June 29.

*Claim.*—"What I claim as my invention is, the design, combination, and arrangement of the several mouldings and ornaments upon the plates forming the stove, and also the configuration of the mouldings and ornaments upon each of the doors, and of the feet, substantially as described and represented."

# MECHANICS, PHYSICS, AND CHEMISTRY.

## *Observations on Etherification.* By Thomas Graham, F. R. S., F. C. S., &c.*

In the ordinary process of etherizing alcohol by distilling that liquid with sulphuric acid, two distinct chemical changes are usually recognised; namely, first, the formation of sulphovinic acid, the double sulphate of ether and water; and secondly, the decomposition of the compound named, and liberation of ether. The last step, or actual separation of the ether, is referred to its evaporation, in the circumstances of the experiment, into an atmosphere of steam and alcohol vapor, assisted by the substitution of water as a base to the sulphuric acid, in the place of ether. The observation, however, of M. Liebig, that ether is not brought off by a current of air passing through the heated mixture of sulphuric acid and alcohol, is subversive of the last explanation, as it demonstrates that the physical agency of evaporation is insufficient to separate ether. Induced to try whether ether could not be formed without distillation, I obtained results which appear to modify considerably the views which can be taken of the nature of the etherizing process.

The spirits of wine or alcohol always employed in the following experiments, was of density 0·841, or contained 83 per cent. of absolute alcohol.

*Expt.* 1.—One volume of oil of vitriol was added to four volumes of alcohol, in a gradual manner, so as to prevent any considerable rise of temperature. The mixture was sealed up in a glass tube, 1 inch in diameter and 6·6 inches in length, of which the liquid occupied 5·2 inches, a space of 1·4 inch being left vacant, to provide for expansion of the liquid by heat. The tube was placed in a stout digester containing water, and safely exposed to a temperature ranging from 284° to 352° (140° to 178° C.) for one hour.

No charring occurred, but the liquid measured on cooling, 5·25 inches in the tube, and divided into two columns, the upper occupying 1·75 inches, and the lower 3·5 inches of the tube. The former was perfectly transparent and colorless, and on opening the tube, was found to be ether, so entirely free from sulphurous acid, that it did not affect the yellow color of a drop of the solution of bichromate of potash. The lower fluid had a slight yellow tint, but was transparent. It contained some ether, but was principally a mixture of alcohol, water, and sulphuric acid. The salt formed by neutralizing this acid fluid with carbonate of soda, did not blacken when heated, from which we may infer that little or no sulphovinic acid was present.

The principal points to be observed in this experiment, are its entire success as an etherizing process, without distillation, without sensible formation of sulphovinic acid, and with a large proportion of alcohol in contact with the acid, namely, two equivalents of the former nearly, to one of the latter. When the proportion of the alcohol was diminished, the results were not so favorable.

* From the Journal of the London Chemical Society, Vol. III., 1851.

*Expt.* 2.—A mixture of one volume of oil of vitriol and two volumes of alcohol, sealed up in a glass tube, was heated in the same manner as the last. The liquid afterwards appeared of an earthy-brown color by reflected light, and was transparent and red by transmitted light. Only a film of ether was sensible after twenty-four hours, floating upon the surface of the dark fluid.

*Expt.* 3.—With a still smaller proportion of alcohol, namely, one volume of oil of vitriol with one volume of alcohol, which approaches the proportions of the ordinary etherizing process, a black, opaque liquid was formed at the high temperature, thick and gummy, without a perceptible stratum of ether, after standing in a cool state.

Crystals of bisulphate of soda, containing a slight excess of acid, were found to etherize about twice their volume of alcohol, in a sealed tube, quite as effectually as the first proportion of oil of vitriol, when heated to the same temperature. The two liquids found in the tube were colorless, no sulphurous acid appeared, and only a minute quantity of sulphovinic acid.

Crystals of bisulphate of soda, which were formed in an aqueous solution and without an excess of acid, had still a sensible but much inferior etherizing power.

*Expt.* 4.—A mixture was made of oil of vitriol with a still larger proportion of alcohol, namely, 1 volume of the former and 8 of the latter, or nearly 1 equivalent of acid to 4 equivalents of alcohol. This mixture was sealed up in a tube and heated for an hour between 284° and 317° (140° and 158° C.), which appeared sufficient for etherizing it. A second exposure for another hour to the same temperature did not sensibly increase the ether product. The column of ether measured 1·25 in the tube, and the acid fluid below 2·5 inches. Both fluids were perfectly colorless.

It thus appears to be unnecessary to exceed the temperature of 317° (158° C.) in this mode of etherizing, and that the proportion of alcohol may be increased to eight times the volume of oil of vitriol without disadvantage.

*Expt.* 5.—The proportions of the first experiment were again used, namely, 1 volume of oil of vitriol with 4 volumes of alcohol, and the mixture heated as in the last experiment to 317° (158° C.) The upper fluid, or ether, measured 1·1 inch in the tube; the lower fluid 2·65 inches. The latter had a slight yellow tint, like nitrous ether, but only just perceptible. It gave, when neutralized by chalk:

| | |
|---|---|
| Sulphate of lime . . . | 83·11 grains. |
| Sulphovinate of lime . . | 4·91 " |

The last salt was soluble in alcohol, and crystallized in thin plates.

Here again the formation of sulphovinic acid in a successful etherizing process is quite insignificant.

New results at 317°, from the other proportions of 1 volume of oil of vitrol with 1 and 2 volumes of alcohol, were quite similar to those obtained in experiments 2 and 3, at the higher temperature of 352°. In none of these experiments, did there appear to be any formation of olefiant gas, and the tubes could always be opened, when cool, without danger.

Neither glacial phosphoric acid nor crystalized biphosphate of soda etherized alcohol to the slightest degree, when heated with that sub-

stance in a sealed tube, to 360° (182°C.). Even chloride of zinc produced no more, at the same temperature, than a trace of ether, perceptible to the sense of smell.

*Expt.* 6.—To illustrate the ordinary process of ether-making, a mixture was prepared, as usually directed, of:

100 parts of oil of vitriol,
48 " of alcohol (0·841),
18·5 " of water.

This liquid was sealed up in a glass tube, and heated to 290° (143° C.) for one hour. It became of a dark greenish-brown color, and opalescent, with a gummy looking matter in small quantity. No stratum of ether formed upon the surface of the fluid.

The tube was opened and the fluid divided into two equal portions. One of the portions was mixed with half its volume of water, and the other with half its volume of alcohol, and both sealed up in glass tubes and exposed again to 290° for one hour.

It would be expected, on the ordinary view of water setting free ether from sulphovinic acid, that much ether would be liberated in the mixture above, to which water was added. The ether which separated, however, amounted only to a thin film, after the liquid had stood for several days. In the other liquid, on the contrary, to which alcohol was added, the formation of ether was considerable, a column of that liquid appearing, which somewhat exceeded half the original volume of the alcohol added. In fact, the sulphovinic acid was nearly incapable of itself of yielding ether, even when treated with water. But it was capable of etherizing alcohol added to it, in the second mixture, like bisulphate of soda or any other acid salt of sulphuric acid.

The conclusions which I would venture to draw from these experiments are the following:

The most direct and normal process for preparing ether, appears to be, to expose a mixture of oil of vitriol with from four to eight times its volume of alcohol of 83 per cent., to a temperature of 320° (160° C.), for a short time. Owing to the volatility of the alcohol, this must be done under pressure, as in the sealed glass tube. The sulphuric acid then appears to exert an action upon the alcohol, to be compared with that which the same acid exhibits when mixed in small proportions with the essential oils. Oil of turpentine, mixed with one-twentieth of its volume of sulphuric acid, undergoes an entire change, being chiefly converted into a mixture of two other hydrocarbons, terebene and colophene, one of which has a much higher boiling point and greater vapor-density than the oils of turpentine. This hydrocarbon does not combine with the acid, but is merely increased in atomic weight and gaseous density without any further derangement of composition, by a remarkable polymerizing action (as it may be termed) of the sulphuric acid. So of the hydrocarbon of alcohol; its density is doubled in ether, by the same polymerizing action. Chloride of zinc effects, with alcohol, at an elevated temperature, a polymeric catalysis of the latter, of the same character, but in which hydrocarbons are formed, of even greater density and free from oxygen.

This view of etherification is only to be considerd as an expression of

the contact-theory of that process which has long been so ably advocated by M. Mitscherlich.

The formation of sulphovinic acid appears not to be a necessary step in the production of ether; for we have found that the etherizing proceeded most advantageously with bisulphate of soda, or with sulphuric acid mixed with a large proportion of alcohol and water, which would greatly impede the production of sulphovinic acid. It appears, indeed, that the combination of alcohol with sulphuric acid, in the form of sulphovinic acid, greatly diminishes the chance of the former being afterwards etherized; for when the proportion of oil of vitriol was increased in the preceding experiments, which would give much sulphovinic acid, the formation of ether rapidly diminished. The previous conversion of alcohol into sulphovinic acid, appears, therefore, to be actually prejudicial, and to stand in the way of its subsequent transformation into ether.

The operation of etherizing has attained a kind of technical perfection in the beautiful continuous process now followed. The first mixture of alcohol and sulphuric acid is converted into sulphovinic acid, the sulphate of ether and water, which acid salt appears to be the agent which polymerizes all the alcohol afterwards introduced into fluid. Bisulphate of soda, with a slight excess of acid, acts upon alcohol in the same manner, and its substitution for the acid sulphate of ether would have a certain interest, in a theoretical point of view, although a change of no practical importance in the preparation of ether.

Sulphuric acid does not appear to be adapted for the etherizing of amylic alcohol. M. Balard, by distilling these substances together, obtained a variety of hydrocarbons, some of them of great density, but no ether. The polymerizing action of the sulphuric acid appears to advance beyond the ether stage. I have varied the experiment by heating amylic alcohol, in a close tube, to 350° (176° C.) with oil of vitriol, to which 1, 2, 3, 4, and even 6 equivalents of water had been added, without obtaining anything but hydrocarbons of Balard. The formation of these was abundant, even with the most highly hydrated acid, and with a very moderate coloration of the fluid.

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## *W. & J. Galloway's Patent Improvements in Steam Boilers.**

In our last number we noticed, briefly, an arrangement of slides for steam engines, lately patented by Messrs. Galloway, in which double ports were employed to afford a better exit of the steam, with other advantages.

We, however, attach a greater importance to Messrs. Galloway's improvements in boilers, which embrace various arrangements of their CONICAL *water tubes.* We believe that boilers on this principle are destined to supersede the ordinary tubular boilers for steam navigation, and if the water tubes in America have not been entirely successful, we attribute it to their not adopting the conical form. We should be glad to see a series of experiments undertaken to prove the relative values of various kinds of boiler surface, for we are convinced that a considerable portion

* From the London Artizan, December, 1851.

of the surface of ordinary tubular boilers is inoperative. If we could reduce the cubic contents of our present boilers only 10 per cent., it would be a gain of no ordinary kind; and when we look at the difference between a flue and a tubular boiler, there appears no reason why as great an advance should not again be made. To illustrate the principle, we have sketched one of a set of four marine boilers, arranged so as to have one chimney, common to the four, in the centre. Fig 1 is a side elevation in section; fig. 2 a front view; fig. 3 a plan in section; and fig. 4 an

Fig. 1.

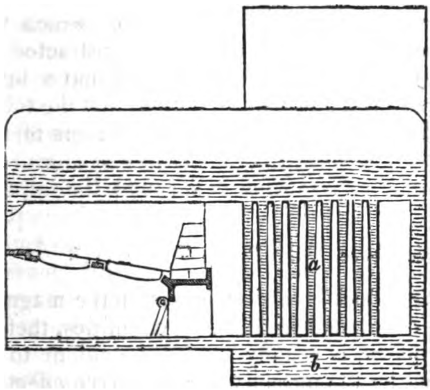



Fig. 2.

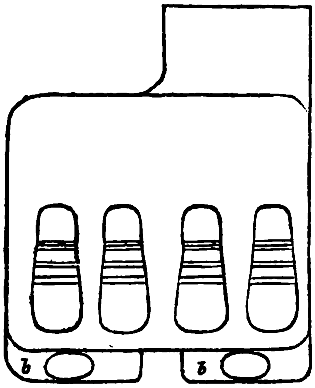



Fig. 3.

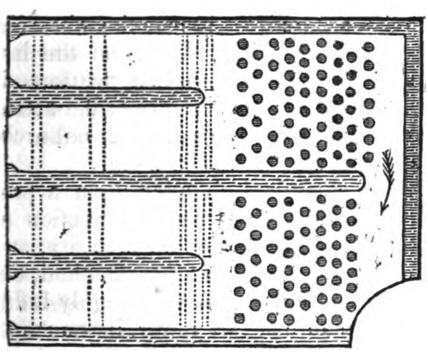
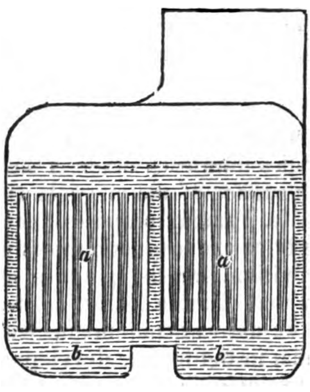


Fig. 4.




end elevation in section across the tubes. The vertical conical tubes, *a*, *a*, are arranged in two rectangular flues behind the furnaces, and are accessible at each end; water spaces of sufficient size, *b*, *b*, being constructed at the bottom, with suitable man-holes. These water spaces drop down between the keelsons, so that the boilers would not occupy any more height than ordinary ones. To return to the question of the value of heating surface. Although this point has never received the attention it deserves, it appears quite rational to suppose that a tube through which a current of water is passing will much more rapidly abstract the heat from the heated air which flows over it, than a tube in

which the current is sluggish, or as is the case with *small, long, cylindrical* tubes, when they are half filled with steam which cannot freely escape. The conical form provides for these requirements admirably. The inclined position of the sides affords a better surface for the flame to act upon, whilst the bubbles of steam, as they are formed, find room to rise freely. It will be observed that the tubes nearest the furnace are placed farther apart than those behind them. The reason for this is obvious. The progress of the flame is not so abruptly arrested, and the heat is diffused more equally over the whole number of tubes, which materially adds to their durability. We hope to be able to give, on some future occasion, a report on these boilers, a trial of which we await with great interest. Since we described the boilers constructed by Messrs. Galloway for the Gutta Percha Company, several have been erected in and around London; and it is a fact worth noting, that the tubes have proved, after two years' use, as durable as the best boilers of the ordinary form.

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### *On the Lines of Magnetic Force.* By PROF. FARADAY.*

That beautiful system of power which is made manifest in the magnet, and which appears to be chiefly developed in the two extremities, thence called ordinarily the magnetic poles, is usually rendered evident to us in the case of a particular magnet by the attractive or repulsive effect of these parts on the corresponding parts of another magnet; and these actions have been employed, to indicate both the direction in which the magnetic force is exerted, and also the amount of the force at different distances. Thus, if the attraction be referred to, it may be observed either upon another magnet or upon a piece of soft iron; and the law which results, for effects beyond a certain distance, is, that the force is inversely as the square of the distance. When the distance of the acting bodies from each other is small, then this law does not hold, either for the surface of the magnets or for any given point within them.

Mr. Faraday proposes to employ a new method, founded upon a property of the magnetic forces different from that producing attraction or repulsion, for the purpose of ascertaining the direction, intensity, and amount of these forces, not to the displacement of the former method, but to be used in conjunction with it; and he thinks it may be highly influential in the further development of the nature of this power, inasmuch as the principle of action, though different, is not less magnetic than attraction and repulsion, not less strict, and the results not less definite.

The term line of magnetic force is intended to express simply the direction of the force in any given place, and not any physical idea or notion of the manner in which the force may be there exerted; as by actions at a distance, or pulsations, or waves, or a current, or what not. A line of magnetic force may be defined to be that line which is described by a very small magnetic needle, when it is so moved in either direction correspondent to its length, that the needle is constantly a tangent to the line of motion; or, it is that line along which, if a transverse wire be

* From the London Athenæum, February, 1852.

moved in either direction, there is no tendency to the formation of an electric current in the wire, whilst if moved in any other direction there is such a tendency. The direction of these lines about and between ordinary magnets is easily represented in a general manner by the well known use of iron filings.

The method of recognising and taking account of these lines of force which is proposed, and was illustrated by experiments during the evening, is to collect and measure the electricity set into motion in the moving transverse wire; a process entirely different in its nature and action to that founded on the use of a magnetic needle. That it may be advantageously employed, excellent conductors are required; and therefore those proceeding from the moving wire to the galvanometer were of copper 0·2 of an inch in thickness, and as short as was convenient. The galvanometer, also, instead of including many hundred convolutions of a long fine wire, consisted only of about 48 or 50 inches of such wire as that described above, disposed in two double coils about the astatic needle: and that used in the careful research contained only 20 inches in length of a copper bar 0·2 of an inch square. These galvanometers showed effects 30, 40, or 50 times greater than those constructed with fine wire; so abundant is the quantity of electricity produced by the intersections of the lines of magnetic force, though so low in intensity.

The lines of force already described, will, if observed by iron filings or a magnetic needle or otherwise, be found to start off from one end of a bar magnet, and after describing curves of different magnitudes through the surrounding space, to return to and set on at the other end of the magnet; and these forces being regular, it is evident that if a ring, a little larger than the magnet, be carried from a distance towards the magnet and over one end until it has arrived at the equatorial part, it will have intersected once all the external lines of force of that magnet. Such rings were soldered on to fitly shaped conductors connected with the galvanometer, and the deflections of the needle observed for one, two, or more such motions or intersections of the lines of force: it was stated that when every precaution was taken, and the results at the galvanometer carefully observed, the effect there was sensibly proportionate for small or moderate arcs to the number of times the loop or ring had passed over the pole. In this way, not only could the definite actions of the intersection wire be observed and established, but also one magnet could be compared to another: wire of different thickness and of different substances could be compared; and also the sections described by the wire in its journey could be varied. When the wire was the same in length, diameter, and substance, no matter what its course was across the lines of force, whether direct or oblique, near to or far from the poles of the magnet, the result was the same.

A compound bar magnet was so fitted up that it could revolve on its axis, and a broad circular copper ring was fixed on it at the middle distance or equator, so as to give a cylindrical exterior at that place. A copper wire being made fast to this ring within, then proceeded to the middle of the magnet, and afterwards along its axis and out at one end. A second wire, touched by a spring contact, the outside of the copper ring, and was then continued outwards six inches, after which it rose and

finally turned over the upper pole towards the first wire, and was attached to a cylinder insulated from but moving round it. This cylinder and the wire passing through it were connected with the galvanometer, so that the circuit was complete; but that circuit had its course down the middle of the magnet, then outwards at the equator and back again on the outside, and whilst always perfect, allowed the magnet to be rotated without the external part of the circuit, or the latter without the magnet, or both together.

When the magnet and external wire were revolved together, as one arrangement fixed in its parts, there was no effect at the galvanometer, however long the rotation was continued. When the magnet with the internal wire made four revolutions, as the hand of a watch, the outer conductor being still, the galvanometer needle was deflected 35° or 40° in one direction: when the magnet was still, and the outer wire made four revolutions as the hands of a watch, the galvanometer needle was deflected as much as before in the contrary direction: and in the more careful experiments the amount of deflexion for four revolutions was precisely the same whatever the course of the external wire, either close to or far from the pole of the magnet.

Thus it was shown, that when the magnet and the wire revolved in the same direction, contrary currents of electricity, exactly equal to each other, tended to be produced; and those outside resulted from the intersection by the outer wire of the lines of magnetic force external to the magnet; that wherever this intersection was made the result was the same; and that there were corresponding lines of force within the magnet, exactly equal in force or amount to those without, but in the contrary direction. That in fact every line of magnetic force is a closed curve, which in some part of its course passes through the magnet to which it belongs.

In the foregoing cases the lines of force, belonging as they did to small systems, rapidly varied in intensity according to their distance from the magnet, by what may be called their divergence. The earth, on the contrary, presents us, within the limits of one action at any one time, a field of equal force. The dipping needle indicates the direction or polarity of this force; and if we work in a plane perpendicular to the dip, then the number or amount of the lines of force experimented with will be in proportion to the area which our apparatus may include. Wires were therefore formed into parallelograms, inclosing areas of various extent, as one square foot, or nine square feet, or any other proportion, and being fixed upon axes equidistant from two of the sides, could have these axes adjusted perpendicular to the line of dip and then be revolved. A commutator was employed and associated both with the galvanometer and the parallelograms, so that the upper part of the revolving wire always sent the current induced in it in the same direction. Here it was found that rotation in one direction gave one electric current; that rotation in the reverse direction gave the contrary current; that the effect at the galvanometer was proportionate to the number of rotations with the same rectangular; that with different sized rectangles of the same wire the effect was proportionate to the area of the rectangle, *i. e.*, the number of curves intersected, &c. &c. The vicinity of other magnets to this magnet made no difference in the effect, provided they were not moved during the ex-

periments; and in this manner the non-interference of such magnets with that under investigation was fully established.

All these and other results are more fully stated and proved in papers now before the Royal Society. The general conclusions are, that the magnetic lines of force may be easily recognised and taken account of by the moving wire, both as to direction and intensity, within metals, iron or magnets, as well as in the space around; and that the wire sums up the action of many lines in one result: That the lines of forces will represent the nature, condition, direction, and amount of the magnetic forces; that the effect is directly as the number of lines of force intersected, whether the intersection be direct or oblique; that in a field of equal force, it is directly as the velocity; or as the length of the moving wire; or as the mass of the wire; that the external power of an unchangeable magnet is definite yet illimitable in extent; and that any section of all the lines of force is equal to any other section; that the lines of force within the magnet are equal to those without; and that they are continuous with those without, the lines of force being closed curves.—*Proc. Roy. Inst., Jan.* 23, 1852.

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## *Observations on the Formation of Sulphuric Acid from Sulphurous Acid and Oxygen.* By Prof. Wöhler.*

It is well known from the experiments of Dœbereiner, and other chemists, that several metallic oxides are capable, like platinum, of supporting the slow combustion of alcoholic vapor. I considered it highly probable that this action would likewise extend to a mixture of sulphurous acid gas and oxygen, and requested M. Mahla to make some experiments on the subject in such a manner that a dry mixture of about two volumes sulphurous acid and one volume oxygen or of atmospheric air were passed over oxide heated in a glass tube to a faint red.

1. *Oxide of Copper, Peroxide of Iron, Oxide of Chromium*, each separately employed, instantly cause the production of dense white fumes of sulphuric acid. A mixture of oxide of copper and oxide of chrome, prepared by precipitation, had in particular a very powerful action. The same amount of oxide appears capable of converting an unlimited quantity of the gases into sulphuric acid. The formation of sulphuric acid proceeds so readily, and to such an extent, that this process will undoubtedly come to be practically employed.

2. *Oxide of Copper and Oxide of Iron*, heated in sulphurous acid without oxygen, are reduced, the first to red protoxide, the latter to black protoperoxide, with production of vapors of sulphuric acid, but which, however, cease to appear as soon as the reduction is complete.

3. *Oxide of Chromium*, heated without oxygen in sulphurous acid, remains unaltered; not a trace of sulphuric acid is formed.

4. *Metallic Copper*, placed in a spongy state over mercury in a mixture of two volumes sulphurous acid and one volume oxygen, exerts at the ordinary temperature, even in the course of several days, no action upon the mixture of gases. But if the spongy copper be heated in it, fumes

*From the London Chemical Gazette, April, 1852.

of sulphuric acid are formed, but not before the copper has become converted on the surface into oxide.

5. *Caustic Lime*, heated in the gaseous mixture, becomes brightly incandescent, and is converted into sulphate without any formation of free sulphuric acid.

6. *Aqueous Vapor*, passed with the gaseous mixture through a porcelain tube at a faint red heat, does not induce the production of the hydrate of sulphuric acid.

7. *Platinum Foil*, polished and cleansed by treatment with hot sulphuric acid, alkali, and water, acts upon the dry gaseous mixture like spongy platinum; far below red heat, it causes with great readiness, the formation of anhydrous sulphuric acid, without the slightest evident alteration at its surface. It does not act at the ordinary temperature.

M. Mahla has found on this occasion that a mixture of peroxide of iron and oxide of copper, prepared by precipitation, and calcined when heated in a jet of hydrogen, becomes red hot like spongy platinum, and remains incandescent.—*Liebig's Annalen, Feb.* 1852.

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For the Journal of the Franklin Institute.

## *Pacific Mail Steamer Golden Gate.*

This vessel is the fastest steamship in the Pacific, and I furnish you with her log for the round trip between Panama and San Francisco; it will be seen that where coal is from $25 to $40 per ton, very great speed cannot be *afforded.*

| | |
|---|---|
| Length on deck, | 265 feet. |
| Breadth of beam, | 40 " |
| Whole depth of hold, | 20 " |
| Depth of hold for tonnage, | 22 " |
| Tonnage, | 2030 tons. |
| Two Oscillating Engines. | |
| Diameter of cylinders, | 7 feet 1 inch. |
| Length of stroke, | 9 " |
| Diameter of paddle wheels, | 31 " |
| Length of paddles, | 12 " |
| Depth of paddles, | 2 " |
| Four Iron Tubular Boilers. | |
| Whole amount of fire surface, | 12052 square feet. |
| Whole amount of grate surface, | 367 " " |

I will mention here, that her cut-off valve is a double beat or balance valve, and it is used at the same time as a throttle, being connected by a rolling joint on a radius bar; the said bar being worked by a cam on the shaft. It is the same size as the steam valve, (15 inches,) and it will only raise three inches, which is sufficient to use all the steam we can make.

Since she has been on this coast there has not, at any time, been less than four different kinds of coal in her bunkers, and almost all of it of a very inferior quality; some of it having been exposed on the beach for eighteen months or two years; and at other times she has taken the refuse out of four or five different ships.

Annexed is the Steam Log from San Francisco to Panama, and back to San Francisco.

| Date. 1852. | Hours of Steaming. | Steam. lbs. | Vacuum. in. | Cut-off. ft. | Cut-off. in. | Throttle. in. | Revolutions. per day. | Revolutions. per hour. | Revolutions. per knot. | Distance. per day. | Distance. per hour. | Coal used. per day. | Coal used. per hour. | Coal used. per knot. | Coal used. Total. tons. | Per cent. of ashes. | Draft of water. ft. | Draft of water. in. | Dip of wheels. ft. | Dip of wheels. in. | Saturation in boilers. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From San Francisco to Panama. | | | | | | | | | | | | | | | | | | | | | | |
| Jan. 21 | 2 | 10 | 25 | 4 | 6 | 2½ | 1532 | 766 | 76½ | 20 | 10 | 9200 | 4600 | 460 | | 23 | 15 | 5 | 6 | 10 | 1¾ | Light winds and calms. |
| " 22 | 24 | 10½ | 25 | 4 | 6 | 2½ | 18416 | 768 | 74¾ | 246 | 10¼ | 105672 | 4403 | 430 | 52¼ | 23 | | | | | 1¾ | |
| " 23 | 24 | 10¾ | 25 | 4 | 6 | 2½ | 19023 | 792 | 76 | 250 | 10½ | 111112 | 4630 | 444 | 55⅝ | 26 | | | | | 1¾ | Fine weather, light breeze, smooth sea. |
| " 24 | 24 | 11 | 25 | 4 | 6 | 2½ | 19503 | 812 | 74¾ | 261 | 10¾ | 115282 | 4803 | 442 | 58⅝ | 28 | | | | | 1¾ | |
| " 25 | 24 | 11 | 25 | 4 | 6 | 2½ | 20234 | 844 | 73⅛ | 277 | 11½ | 126948 | 5290 | 458 | 63⅓ | 36 | | | | | 1¾ | |
| " 26 | 24 | 9 | 25 | 4 | 6 | 2½ | 20260 | 844 | 70½ | 287 | 12 | 137952 | 5831 | 480 | 69⅞ | 38 | | | | | 1¾ | |
| " 27 | 24 | 9 | 25 | 4 | 6 | 2½ | 20006 | 875 | 69 | 290 | 12½ | 117368 | 4890 | 405 | 58¾ | 28 | | | | | 1¾ | |
| " 28 | 20 | 10½ | 25 | 4 | 6 | 2½ | 17672 | 883 | 71 | 249 | 12½ | 90576 | 4528 | 364 | 45¾ | 23 | 13 | 0 | 4 | 6 | 1¾ | Light winds and calms all these days. |
| " 29 | 12 | 10 | 25 | 4 | 6 | 2 | 9065 | 824 | 59¾ | 252 | 12⅔ | 75344 | 4432 | 495 | 37⅔ | 16 | 13 | 7 | 5 | 0 | 1¾ | Stopped at Acapulco 16 hours. |
| " 30 | 24 | 12 | 25 | 4 | 6 | 2½ | 20575 | 857 | 79½ | 259 | 10¾ | 103850 | 4328 | 401 | 56⅞ | 20 | | | | | 1¾ | |
| " 31 | 24 | 11⅓ | 25 | 4 | 6 | 2½ | 21065 | 878 | 89⅔ | 235 | 10 | 114704 | 4779 | 488 | 57⅓ | 20 | | | | | 1¾ | |
| Feb. 1 | 24 | 11 | 25 | 4 | 6 | 2½ | 20995 | 873 | 81⅛ | 259 | 10¾ | 120632 | 5026 | 465 | 60⅓ | 20 | | | | | 1¾ | Strong breeze from eastward. |
| " 2 | 24 | 10⅓ | 25 | 4 | 6 | 2½ | 21460 | 894 | 77 | 280 | 11⅔ | 120088 | 5004 | 429 | 60 | 20 | | | | | 1¾ | Rain squalls and calms. |
| " 3 | 16 | 10½ | 25 | 4 | 6 | 2 | 13184 | 824 | 70⅛ | 188 | 11¾ | 74664 | 4666 | 397 | 37⅓ | 21 | 12 | 3 | 3 | 8 | 1¾ | Strong breeze and tide against us. |
| From Panama to San Francisco. | | | | | | | | | | | | | | | | | | | | | | |
| Feb. 12 | 8 | 12 | 25 | 4 | 6 | 2½ | 6280 | 785 | 89¾ | 70 | 8¾ | 54536 | 6817 | 779 | 27¼ | 19 | 15 | 11 | 7 | 4 | 1¾ | Light wind, sail set running down bay, 90 miles. |
| " 13 | 24 | 11½ | 25 | 4 | 6 | 2½ | 18215 | 759 | 85½ | 213 | 8⅞ | 130532 | 5438 | 614 | 65¼ | 19 | | | | | 1¾ | Light head winds. |
| " 14 | 24 | 11⅔ | 25 | 4 | 6 | 2½ | 18830 | 784 | 79⅛ | 238 | 10 | 122944 | 5122 | 516 | 61½ | 20 | | | | | 1¾ | |
| " 15 | 24 | 11⅔ | 25 | 4 | 6 | 2½ | 19020 | 792 | 79¾ | 274 | 11½ | 116280 | 4845 | 425 | 58⅓ | 19 | | | | | 1¾ | Strong breeze and rough head sea. |
| " 16 | 24 | 11 | 25 | 4 | 6 | 2 | 18725 | 780 | 74⅓ | 252 | 10½ | 128754 | 5364 | 511 | 64⅜ | 21 | | | | | 1¾ | |
| " 17 | 24 | 10½ | 25 | 4 | 6 | 2¼ | 19130 | 797 | 77¾ | 246 | 10¼ | 123646 | 5151 | 503 | 61¾ | 22 | | | | | 1¾ | Moderate breezes and head sea. |
| " 18 | 13½ | 11¾ | 25 | 4 | 6 | 2 | 11367 | 844 | 74⅓ | 153 | 11¼ | 61855 | 4418 | 404 | 31⅞ | 22 | | | | | 1¾ | Fine weather and calms; stopped at Acapulco 25½ hours. |
| " 19 | 9 | 10⅓ | 25 | 4 | 6 | 2¼ | 6391 | 710 | 66⅔ | 96 | 10⅔ | 50874 | 5653 | 530 | 25⅜ | 21 | | | | | 1¾ | |
| " 20 | 24 | 11 | 25 | 4 | 6 | 2½ | 19680 | 820 | 77½ | 254 | 10½ | 120640 | 5026 | 475 | 60¼ | 20 | | | | | 1¾ | Fine weather and calms. |
| " 21 | 24 | 11½ | 25 | 4 | 6 | 2½ | 20385 | 849 | 80¼ | 254 | 10½ | 123666 | 5152 | 487 | 61¾ | 20 | | | | | 1¾ | |
| " 22 | 24 | 11¾ | 25 | 4 | 6 | 2½ | 20555 | 856 | 79⅔ | 258 | 10¾ | 127424 | 5309 | 494 | 63¾ | 20 | | | | | 1¾ | Strong breeze and head sea. |
| " 23 | 24 | 11½ | 25 | 4 | 6 | 2¼ | 20670 | 861 | 80⅛ | 258 | 10¾ | 115092 | 4795 | 444 | 57½ | 20 | | | | | 1¾ | Light head winds and fine weather. |
| " 24 | 24 | 10⅔ | 25 | 4 | 6 | 2 | 20687 | 862 | 78⅓ | 264 | 11 | 113729 | 4738 | 431 | 56¾ | 20 | | | | | 1¾ | |
| " 25 | 24 | 11 | 25 | 4 | 6 | 1¾ | 21238 | 885 | 80½ | 264 | 11 | 112342 | 4680 | 425 | 56¼ | 21 | | | | | 1¾ | Strong breeze and head sea. |
| " 26 | 17½ | 10 | 25 | 4 | 6 | 1½ | 15384 | 880 | 80⅛ | 192 | 11 | 78257 | 4475 | 408 | 39¼ | 21 | 12 | 00 | 3 | 6 | 1¾ | |

For the Journal of the Franklin Institute.

## *List of the Engineer Corps of the U. S. Navy.*

*Chief Engineers.*

Charles H. Haswell,
William P. Williamson,
William Sewell, Jr.,
William W. W. Wood,
Henry Hunt,
Daniel B. Martin,
Joshua Follansbee,
Benjamin F. Isherwood,
Jesse Gay,
Samuel Archbold,
George Sewell.

*First Assistants.*

Nailor C. Davis,
Wm. Everett,*
Wm. H. Shock,*
James W. King,*
Michael Quin,
Geo. F. Hebard,
Wm. K. Hall,
John P. Whipple,
Elbridge Lawton,
Henry Mason,
James G. Young,
John Alexander,
Jesse S. Rutherford,
Robert Danby,
Wm. Holland,
Benjamin F. Garvin,
E. A. Whipple,
Theodore Zeller,
Thomas Kilpatrick,
Henry H. Steward,

* Passed as Chief Engineers but not yet Commissioned.

*Second Assistants.*

Charles W. Geddes,
John W. Parks,
Nathaniel Patterson,
Robert H. Long,
Alban Stimers,
Thomas A. Stephens,
John Farm,
F. C. Dade,
Geo. T. W. Logan,
E. S. DeLuce,
Harman Newell,
Montgomery Fletcher,
George Gideon,
Edward Fithian,
Wm. C. Wheeler,
D. B. Macomb,
Eli Crosby,
Andrew Lawton,
Wm. H. King,
Richard C. Potts,
J. C. E. Lawrence,
J. M. Maury,
James M. Adams,
Simon B. Knox,
Amos Broadnix,
Wm. A Latimer,
Jackson R. Hatcher,
James M. Hobby,
Daniel T. Mapes,
James H. Warner,
Washington H. Nones,
William H. Rutherford,

*Third Assistants.*

Geo. W. Alexander,
Thomas A. Jackson,
T. A. Shock,
Wm. J. Lamdin,
Charles H. Loring,
William S. Stamm,
H. S. Barker,
S. H. Houston,
C. W. Lee,
S. E. McElroy,
G. F. Barton,
Oscar Davids,
Alexander Henderson,
T. B. C. Stump,
C. H. Mannson,
C. T. Parke,
Virginus Freeman,
George E. DeLuce,
S. D. Hibbert.
J. R. Pomeroy,
P. H. Taylor,
George Johnson,
M. Kellog,
J. C. Hull,
J. C. Mitchell,
Wm. Gorton,
H. Fauth,
E. Robie,
H. Haines,
H. C. Jewell,
Wm. B. Brooks,
Samuel C. Sherry,
L. Arnold,
L. A. Williamson,
H. W. Spooner,
G. E. Shock,
J. D. Mercer,
J. M. Freeman.

| | |
|---|---|
| Chief Engineers, | 11 |
| First Assistants, | 20 |
| Second Assistants, | 32 |
| Third Assistants, | 38 |
| Total, | 101 |

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For the Journal of the Franklin Institute.

## *The Collins Steamships.*

In a recent number of the *Journal*, I had occasion, in replying to an article by *Britannicus*, (published in the *London Builder*, Oct., 1851,) to deny that the engines, boilers, &c., of the Collins steamers were in any way designed by English Engineers, and that whatever merit they might have, it was our own. The attention of Mr. James Brown, President of the Collins Line, having been drawn to the article before alluded to, he

addressed a note to Messrs. Stillman, Allen & Co., of the Novelty Works, New York, on the subject, and received the following reply:—

"James Brown, Esq.—Dear Sir: We enclose the piece cut from *Galignani's Messenger.* It is quoted from the *London Builder*, and it is strange, indeed, that misrepresentations so utterly without any foundation, should find a place in any journal of any respectability.

"The writer states, as '*from undoubted authority, and as regards some particulars from his own knowledge,*' *that* '*the contractors of the American Line obtained permission from the proprietors of the Cunard Line, to take mouldings or castings of every part, even to the minutest particular, of the engines constructed by Napier, of Glasgow, on board the largest of their vessels.*'

"It does not seem to have occurred to the author of this remarkable assertion, whether it was very probable that the proprietors of the Cunard Line would feel disposed to render any such aid to a rival company, nor does he explain by what mechanical process, the ignorant Yankees were able 'to take mouldings or castings of every part, even to the minutest details of engines' on board of a vessel.

"How utterly without foundation this assertion is, any may see, who will barely look at the two sets of engines; even a casual glance is enough to show their utter dissimilarity throughout, in plan, and in detail; not one piece of one is like one piece of the other; on this point, the engines speak for themselves. They differ about as much as two sets of side lever engines can differ.

"But according to this writer, the possession of all the mouldings or castings was not enough, and, therefore, (he goes on to say,) 'in order that nothing might be wanting to make the engines equal to those in the Cunard steamers, the contractors imported men from the manufactories on the Clyde, for the purpose of making engines in New York.'

"A few facts will show the grossness of this misrepresentation, and exhibit the purely American character of the engines we built for your company.

"Of the proprietors of our concern, every one is a native of the United States, and acquired here whatever mechanical skill or knowledge he possesses.

"Of our foremen, every man (with one exception) was born in the United States, learned his trade in this country, and whatever they have done, in connexion with marine engines, has been at our works. The one exception referred to has been employed at our works for the last 19 years, and never did any work for marine engines in any other place.

"The draftsmen who made the drawings are our pupils, and acquired all the knowledge and experience they have in connexion with steam engines, in our drawing room. The men who superintended the setting of the engines are also natives of the United States, were once our apprentices, and acquired at our works whatever skill and experience they have.

"No man was ever imported from the manufactories of the Clyde, or from any other quarter, with reference to these engines, and neither in the preparation of the plans, nor in the construction of the work, did we ever receive any assistance, direct or indirect, from any engineer on the banks of the Clyde, or from any other part of Great Britain.

"In short, the engines were made of American iron, forged, or melted with American coal; they were planned by American heads, and put together by American hands. In plan, and many important features, they differ, not merely from the Cunard engines, but also from any ever built on the other side of the Atlantic, and we are happy to find that their excellence is so far acknowledged, as to render our English friends anxious to claim the credit of having produced them. Respectfully, yours,

STILLMAN, ALLEN & Co.

"*Novelty Iron Works, New York, Dec.* 23, 1851."

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*On an Improved Boiler for Marine Engines.* By MR. ANDREW LAMB, of Southampton.*

The Peninsular and Oriental steamship *Ripon* is an iron vessel, of 1650 tons burthen, and has two oscillating engines, of 450 nominal horse power. She was built by Messrs. Wigram, in 1846, and was supplied with her machinery by Miller, Ravenhill & Co., of London, since which time she has been almost constantly running for the conveyance of the Indian Mail from Southampton to Alexandria.

Her average speed for the whole of this time has been 9·1 knots per hour. The boilers fitted to her by Messrs. Miller were of the ordinary tubular construction. They were in six pieces, had twelve furnaces, and 744 iron tubes, 3¼ inches outside diameter, 6 feet 6 inches long. The total fire-bar surface was 212 square feet, and the heating surface in tubes 3798 square feet, reckoning the whole of the inside surface of the tubes as effective.

The sectional area through tubes equals 36½ square feet; ditto through ferules, 28 square feet. These boilers were loaded to 10 lbs. on the square inch, but in consequence of being deficient in steam, the actual pressure attained at sea very seldom exceeded 4 to 6 lbs. when full steam was admitted to the cylinders; of course, the engineers found it to their advantage to keep it up to its full pressure by working the expansion apparatus. This deficiency of steam was found to be an increasing evil, the cause for which may be satisfactorily explained by a little consideration of the *modus operandi* of the sea-going tubular boiler. When commencing running with the boilers new, for a short period, dependent on the species of coal consumed, the tubular boiler offers its greatest advantage, and is, in fact, when properly constructed, as good an apparatus for evaporating water as can be imagined applicable to marine purposes. The tubes give an immense amount of heating surface, and in small compass, and from their form are capable of resisting great pressure, but after three or four days' steaming, these advantages diminish. The tubes have an accumulation of soot and light ashes inside them, which, by reducing their sectional area, sometimes from 50 to 75 per cent., diminishes the draft through the furnaces in the same proportion, and also reduces the effective heating surface to the same serious extent. This accumulation depends in quantity very much upon the coal. On one occasion the author was present in a vessel with tubular boilers, burning Scotch coal,

* From the London Artizan, March, 1852.

and they actually came to a dead stand, after only sixty hours' steaming, the tubes being nearly choked up, and requiring to be swept. When tubular boilers have made a few voyages at sea, the outside of the tubes becomes encrusted with saline matter, which gradually accumulates upon them, chiefly upon their bottom sides, and which hitherto it has been found impossible to remove by any other means than scaling them mechanically. The situation of the tubes (row over row) prevents this being accomplished, excepting upon the upper tiers, and the consequences are, that the tubes become coated with a crust $\frac{1}{4}$ or $\frac{3}{8}$ths of an inch thick, and the tube-plates also, which from its non-conducting nature greatly retards the transmission of the heat through it, and the tube plates becoming hot, crack and blister, and deteriorate very rapidly.

For the boiler to be described in the present paper, invented and patented by the author in conjunction with Mr. Summers, the following advantages are claimed over its tubular competitor:—

1st, That, while it possesses an equal amount of heating surface in the same space as tubular boilers, it is free from the evil of choking with inside deposits of soot and ashes, because the flues being in one sheet for their whole depth, the deposit falls into the bottom of the flues, and is swept by the draft through into the up-take, and thence into the chimney.

The flues are flat rectangular chambers, 6 feet 9 inches long, and 3 feet 3 inches high, open at each end, where they are fixed to the boiler. There are seven of these flues to each fire grate; the smoke spaces are $1\frac{3}{4}$ inches wide, and the water spaces $2\frac{5}{8}$ inches. The sides of the flues are $\frac{1}{4}$-inch thick, and they are supported by stays, fixed inside the flues. From this circumstance of there being no stays or other projections in the water spaces, an important advantage is gained—that no nucleus is offered round which the soale can collect, and no impediment to interfere with the complete and rapid cleansing of the water spaces from scale by means of the ordinary scrapers.

In another arrangement of these boilers, adapted for large screw steamers, and also for war steamers, the flues are placed alongside the furnaces and at the same level, instead of over the furnaces, as in the engravings, which arrangement protects the boilers from shot, by keeping them below the water line.

In these improved boilers, the same amount of heating surface can be obtained in the same capacity of boiler as with tubes; the only difference is, that if the tubes are $\frac{3}{16}$ths of an inch thick, they will of course be rather lighter than $\frac{1}{4}$-inch plates; but this difference, as compared with the gross weight, is so small as to be unimportant. In the event of any accident to any of the flues, they may be taken out, separately or collectively, to be repaired or replaced with new ones; but from the facility with which they can be kept clean, they ought, as in the old-fashioned flue boilers, to wear out the shell; the length of time being remarkable that a *thin* plate will last, if kept clean, and never overheated.

The last boilers of this construction examined by the author were those of the *Tagus*, 280 horse power, and in those boilers, after six days' steaming, the deposit was only three inches deep in the bottom of each flue;

and the total depth of the flues being 3 feet 8 inches, it follows that she had only thus lost about 6 per cent. of sectional area.

2d, That the improved flues, from having no projection either of rivet heads or stays in the water spaces, offer no obstructions whatever to the scaling tool, and are as easily kept clean as any part of any boiler can possibly be, thereby entirely removing the evil of a loss of heat through non-conducting deposits, and very much increasing the durability of the boiler.

3d, That the water spaces between the flues being comparatively large, and the sides of the flues perfectly vertical, the circulation of water in the boiler must necessarily be much more perfect than amongst a number of tubes, (amounting sometimes to thousands,) where the water has to wend its way in and out in curved lines. This greater perfection of circulation, the author thinks, must add greatly to the effectiveness of the heating surface in the improved flues.

It must be here mentioned, that these advantages do not now rest upon theory only, and that they have been fully realized by experience.

The first boilers fitted with these flues were those in the *Pacha*, in October, 1849, similar to those shown in the engravings, and up to the time of her unfortunate loss, these boilers gave entire satisfaction. Then followed a small boat, in January, 1850, and the *Tagus*, in August, 1850, since which their success has been rapid, as a proof of which, numerous vessels of different companies are being and have been fitted with them. The *Tagus* has now the oldest of the boilers, and there is in no part of them any signs of deterioration whatever; in fact, they are in every way perfect. There has never been any leakage, and the consumption of fuel is less than with her former tubular boilers.

The improved boilers now fitted to the *Ripon* were manufactured by Messrs. Summers, Day, and Baldock, of Southampton, and are in four parts, the boilers being placed in the wings, two forward of the engines, and two aft; the stoke-holes are thus in midships.

The space occupied by these new boilers is the same as the old ones, the arrangement mentioned having economized as much room as the increased size of boilers required, so that the same quantity of coal is carried in the same space as before. The new boilers have 16 furnaces and 246 square feet of fire-bar surface; 112 flues, 3 feet 9 inches deep × 6 feet 3 inches long, being 5440 square feet of heating surface, reckoning the whole inside surface (as in tubes); the sectional area through the flues, deducting the stays, = 54 square feet.

This large sectional area can be diminished at pleasure by a grating damper, which is hung at the front end of the flues, and extends about 10 or 12 inches down them, and which is worked by handles placed outside the boiler, and between the hinges of the smoke-box doors. The engineer can thus regulate the intensity of his draft at pleasure, according to the variety of the coal in use, &c., &c.

The new boilers of the *Ripon* are loaded to 13 lbs. per square inch; the flues being strongly stayed inside, would of course resist a far higher pressure with perfect safety; in fact, if required, they might easily be sufficiently stayed to resist steam of any pressure.

The *Ripon*, at the same time that the boilers were altered, had her com-

mon radial paddle wheels replaced by feathering ones, which consequently added much to the speed of the vessel.

The best speed of the engines of the *Ripon*, with the old arrangement, was about 15 revolutions per minute, and that of the vessel about 10 knots per hour, when quite light.

On the trial at the measured mile, December, 1851, the vessel was drawing 16 feet 3 inches forward, and 16 feet 7 inches aft; she had all her coal (422 tons) on board, her water, and some cargo, and consequently was pretty deep loaded. The speed of the engines was 19½ revolutions per minute, and of the vessel 11·3 knots per hour. Had she been light, as in the former trial, she would have probably gone over 12 knots. It appears, therefore, that the improvement in speed may be fairly stated as two knots per hour. The cylinders of the engines are 76 inches diameter × 7 feet stroke. Their nominal horse power formerly, at 15 revolutions, would be 404, and at 19½ revolutions, 526 horse power; so that the new boilers have given 122 horse power more steam, of an increased pressure of 3 lbs. per square inch, than the old ones. As the *Ripon* is now making her first voyage with the new boilers, the author cannot speak with any certainty about her consumption, but will give some details of the Peninsular and Oriental steam ship, *Bentinck*, which has made one voyage to Alexandria and back, with these improved boilers and feathering wheels.

The *Bentinck* is a wooden vessel, built by Wilson, of Liverpool, in 1844, and has side lever engines, by Fawcett and Preston. She is 2020 tons burthen, and her engines are 520 nominal horse power; her original boilers were of the old flue construction, and were loaded to 6 lbs. per inch pressure; her average speed at sea was 9 knots per hour, and her engines about 14 revolutions per minute.

The speed of the *Bentinck* is now over 11 knots per hour. The former consumption was about 37 cwt. per hour; the present consumption averages about 38 cwt. per hour.

It must be noticed that the Peninsular and Oriental Company had tubular boilers, with brass tubes, made for this vessel by Messrs. Bury, Curtis, and Kennedy, and that they were brought to Southampton, and placed in the *Pottinger*, a sister ship of the *Ripon*, and of 450 nominal horse power, with common paddle wheels; these boilers are of exactly the same size as the patent boilers made for the *Bentinck*, and they are both loaded to the same pressure, viz: 12 lbs. per square inch; they have each made a passage to Alexandria and back, and, contrary to all expectation, the *Bentinck*, although her engines are 70 horse power nominal more than the *Pottinger*, and are working up to 103 horse power more, has consumed 128 tons less coal than the *Pottinger*, and performed the same distance in 68¼ hours less time. This result of diminished consumption is undeniably a fair triumph for the improved boiler; as for the improved speed of the vessel, it must share the honors with the feathering paddle wheel; the *Bentinck* has made the fastest passage on record between the ports mentioned.

In conclusion, the author can only say, that he believes the improved boiler, described in the present paper, will become the marine boiler generally adopted; as its merits are evident, and its cost is not greater

than tubular boilers; while its durability will, he thinks, be very much greater. He will be happy to show these boilers to any of the members of the institution who may have an opportunity of seeing those that may be in port, or at Mr. Summers' works at Southampton, where there are now five sets in course of construction. It may be added, that the screw steam ship *Glasgow*, by Messrs. Todd and McGregor, which has lately made the fastest run across the Atlantic of any screw steamer, is fitted with these improved boilers; Messrs. Todd and McGregor have made a considerable number of them, and they are also being manufactured by several others. It is intended also to adopt these boilers in the *Himalayah*, now building for the Peninsular and Oriental Company, of upwards of 3000 tons burthen, to be propelled by oscillating engines of 1200 horse power.

Fig. 1.

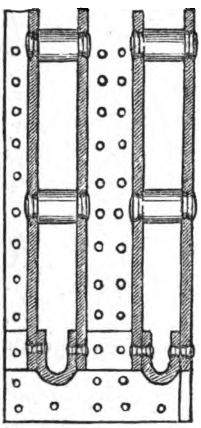


Fig. 2.

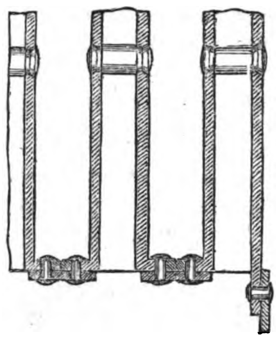
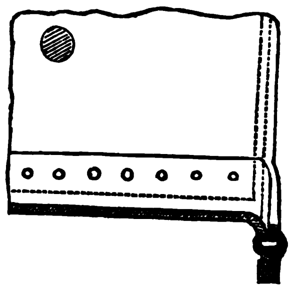


Fig. 3.



The details of construction of the flues are shown in figs. 1, 2, and 3; fig. 1 is a transverse section, fig. 2 a plan, and fig. 3 a longitudinal section of a portion of the flues shown on an enlarged scale. They are constructed of two flat side plates, $\frac{1}{4}$-inch thick, flanched outwards at each end, to meet the plates of the adjoining flues; the top and bottom of each flue is formed by the curved connecting piece, which is riveted to each side plate, and flanched outwards at the ends. The stays or studs are $1\frac{1}{8}$ inch diameter, and are riveted at each end through the side plates. The rivets connecting the plates together, and the stays, are all put into their holes simultaneously, and riveted cold by machinery. These rivets have countersunk heads and points, and when placed in their holes in the plates, a steel bar is inserted, which fills up the space between the heads of the two rows of rivets, and acts as a bolster to the riveting tool. By this means, one stroke of the machine closes two rivets at once, and in the most efficient manner. The flues are afterwards riveted together with covering strips, at their ends, and they are inserted into the boiler in sets of seven or eight, according to the size of the furnace.

Any one of the flues can be readily extracted from the others, if necessary, by cutting away the two rows of rivets at each end, and drawing it out through the front smoke-box doors. The experience which they have

had of the durability of the flues has, however, satisfied those who have employed them, that unless gross negligence of the engineer should (through want of water) allow them to get red hot, the flues will in all cases outlive the shells in which they are inserted. Drawings of the boilers will be found in the *Artizan* for December, 1850.—*Proc. Inst. Mech. Eng.*

The improved steam boiler of Lamb and Sumner has been secured by patent in this country, and is being used by the Navy Department on board the steamers *Princeton* and *Alleghany.*

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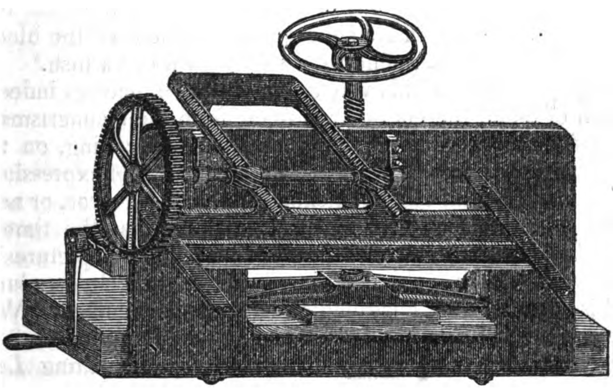
## *Engraved Photographs—Bottier's Paper Cutting Machine—Colt's Revolver.**

It is now some time since we threw out an idea as to the prospective advantages of bringing the photographic process into more immediate connexion with the engraver's art, and pointed to the more than probable chance of fitting it for the part of the engraver's draftsman, in actually pencilling out the lines for the wood graver, the etching needle, or the burin. Considered in relation to engraving directly through the photographs themselves on copper plates, for the purpose of producing large plate engravings, such as are to be found interspersed throughout our own pages, we have, so far, seen no reason for a change of opinion upon the practical difficulties surrounding the project. We have, however, more especially contemplated its fitness for the smaller and otherwise more manageable work of the wood-engraver; and we can now point to the engraving which illustrates this article, as being a further illustration of the soundness of our earlier views.



[Engraved from a Collodion Film transferred to the wood.]

We may be wrong, and we are ready and willing to be set right if we are so, but we believe the annexed engraving of "M. Bottier's Paper Cutting Machine" to be the first published example of this branch of the economics of the atelier. We believe it to be the first engraving which

*From the London Practical Mechanic's Journal, May, 1852.

has been produced after the "pencillings of light." Our first theoretical notion, seeing the then apparent impossibility of engraving an actual daguerreotype plate, was to take the photographic picture on tissue paper, and lay this down on the plate or wood block, and engrave the design through it. Then we hit upon the plan of silverizing the wood block, placing it in the camera for the image, and finally engraving it direct. This project has not yet been realized, although the recent discovery of albumenized and collodionized glass has brought us within one stage of its accomplishment. At our suggestion, Mr. Urie, the artist to whom has been intrusted the execution of the whole of the wood engravings given in this *Journal*, turned his attention to these views of the subject. After long and careful experiments, he seized upon the collodion system as best suited for his purpose, and his success with it is best evidenced in the perspective figure of the machine to which we have already referred.

After obtaining the picture upon the collodion coating in the usual manner, he detaches the thin collodion film from its glass base, and lays it on the prepared wood block, just as we had previously proposed to do with the paper image. The engraver then engraves through the film, as if he were treating an actual drawing upon the wood surface.

It is obvious that the whole process, more especially the transfer of the pictorial film from its original foundation to the block, is a matter involving excessive nicety of manipulation. The operator proceeds by floating off the film in water, by placing the glass plate horizontally therein, and with the picture upwards, assisting the dislodgment of the film, when necessary, by slight mechanical action. Then, the wood block having its surface previously prepared with white of egg and lamp-black—the darkening being necessary to throw out the picture from its translucent ground—the film is carefully laid upon the block; the white of egg having sufficient adhesive power to hold it firmly down. At first, the very obvious difficulty of the peeling off, or disintegration of the film, opposed the efforts of the engraver in his subsequent treatment of the block; but the brittleness has been overcome by a slight wash of varnish.

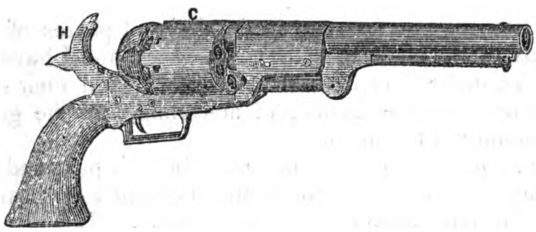
Engravings produced in this way are light drawn pictures indeed. In his execution of them, the engraver is freed from the mannerisms or imperfections of the artist or mechanical draftsman, escaping, on the one hand, the dangers of the lack of "life," or the missing of expression; and, on the other, avoiding all inconvenience from chance, error, or neglect.

We are now more than ever inclined to think that the time is approaching when the engraver may produce his own "sun pictures" of all external views of existing objects, directly on his blocks—reducing or enlarging his scale with all imaginable facility and accuracy. What we have shown is a great step towards this end—of *its* powers of faithful rendering, our readers may satisfy themselves, by consulting *Le Genie Industriel*, for a comparison of our reduced figure, with M. Bottier's original drawing.

In the interval of writing and printing the present paper, Mr. Urie has succeeded in making daylight his "draftsman" on the wood. The little figure of Colt's "revolver," or "repeating pistol," given below, has been reduced directly on the wood, in the camera, from a larger sketch of Col.

Colt's. The history of the operator's course of procedure may be summed up in few words. He first tried a coating of ordinary printer's ink for the blackened coating of the wood, varnishing this over with white wax, which was finally covered with the collodion film. This was a failure, from the mingling of the collodion with the wax, and the camera produced an image which shortly left a mere white ground. The difficulty now was, how to procure a good intermediate varnish, and mastic, shellac, and copal, were all successively tried and laid aside. Then, in retracing the process, the printers' ink was discarded, and a mixture of lamp-black and white of egg substituted as the ground, with a naphtha solution of gutta percha as a varnish beneath the collodion.

But the best results have been obtained by drying on a coating of lampblack and white of egg, and varnishing this over with a coat of pure white of egg alone before laying on the collodion. The accompanying sketch of the pistol was so produced. After collodionizing the wood, it is dipped into nitrate of silver, and placed at once in the camera,




[Engraved from a Collodion Photograph taken directly on the wood.]

the picture being subsequently developed by dipping in sulphate of iron and nitric acid, washed in pure water, and finally fixed with hypo-sulphite of soda, just as in the process given by our correspondent, "H. R." at page 209 of our 4th volume. To preserve the picture, a final coat of mastic varnish is laid on.

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Translated for the Journal of the Franklin Institute.

## *Note on the Crystals contained in Glass.* By M. Leydolt, of Vienna.

I have been for some time employing myself in the crystallographic study of the silicates; and in this way have been led to submit them to the action of fluorhydric acid, for the purpose, especially, of distinguishing the constituent parts of the compound minerals, such as the agates. The crystallized quartz remaining untouched, forms prominences on the plane of the agate, so that after copying this design in relief, by means of galvano-plastic processes, we may take impressions, which are true etchings, and which give, with an exactness which the graver could never reach, all the so varied, and often so complicated intèrior conformation of the agates.

In proceeding in the same way with glass, I was astonished to see that glass is not a homogeneous substance, whatever may be its chemical composition; all the glasses which I have been able to procure, contain a

greater or less number of perfectly distinct, regular, and transparent crystals, which are imbedded in the amorphous material; to make them visible, it is only necessary to submit a slip of glass to the action of hydrofluoric acid gas, mixed with vapors of water. The operation is stopped the moment the crystals are uncovered by the dissolving of the surrounding amorphous part, which is generally more soluble than they, and the figures thus obtained, may be reproduced by the galvano-plastic processes.

The operation presents no difficulty; it is only necessary to place the slip of glass, on a certain inclination, in the mixture of sulphuric acid and fluor spar, which is used to produce the fluorhydric acid, so that one part of the slip may be plunged in the liquid, and the other be without it; the crystals then become visible above the line of separation, upon that face of the slip which is turned towards the liquid. These crystals also appear on the inner surface of bottles in which very weak fluorhydric acid has been kept, but they are then accompanied by broken lines and concentric circles analogous to those of agate.

These crystals may be followed in the different phases of their formation by means of the slags of smelting furnaces, and I have in this way been able to persuade myself that their number and their development depend essentially on the manner of annealing, and the greater or less rapidity of cooling of the mass.

There are also natural crystals perfectly formed, pure and transparent, which present the same defects of homogeneousness as glass, when they are submitted to the action of different solvents. This is a new subject of study with which I am at the present time employed.—*Comptes Rendus de l'Academie des Sciences*, (*Paris*,) 12*th April*, 1852.

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Translated for the Journal of the Franklin Institute.

## *Note on the Incrustations in Steam Boilers.* By M. Delandre.

With well or spring waters, the evaporation produces the precipitation of the earthy salts, and gives rise to the incrustations which become so adherent to the wall of the boilers and the tubes that they cannot be detached. When nevertheless it is desirable to continue to use the boilers, a less quantity of steam is generated with a greater expense of fuel, and often the metal becomes softened in the parts where the incrustations are the thickest and nearest the fire, thus occasioning cracks and finally explosions.

To obviate the destruction and dangers in the use of steam, caused by the incrustations, the aggregation of the earthy and calcareous salts must be prevented, by making them soluble in place of insoluble as they were.

Now the protochloride of tin, under the influence of water, is converted into an insoluble basic subsalt, and a soluble acid salt, which dissolves the earthy salts.

After having undergone, for a long time, great annoyances in the use of tubular boilers, in spite of the use of known preservatives, I have for a year past obtained the perfect protection of these generators from incrustations, by placing 4 kilogrammes (8 lbs.) of protochloride of tin in a

boiler which works 12 hours every day, at a pressure of 3 atmospheres, and consumes in that space of time from 1500 to 1600 litres (400 galls.) of water, and is only emptied and refilled once a week.

For steam boilers which are emptied every day, and are of great power, the consumption of the protochloride of tin should be calculated at 1 kil. (2 lbs.) per cubic metre (35¼ cub. feet).

My tubes, stop cocks, and machines, which were also finally covered with incrustations, have been kept in the most perfect state of cleanliness.—*Comptes Rendus de l'Academie des Sciences, (de Paris,) 29th March,* 1852.

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## *On a Continuous Expansion Steam Engine.* By Mr. James Samuel, of London.*

The economy of working steam expansively is well known, but the application of the expansion principle is practicable only to a limited extent in most forms of engine, from practical difficulties in their mode of working, which prevent the attainment of the full economy of which the expansive principle is capable.

The greatest useful effect is obtained from the steam, when it is allowed to expand in the cylinder until its pressure upon the piston just balances all the useless resistances of the friction of the engine itself, and the resisting pressure on the back of the piston, (whether the pressure of the atmosphere, in a high pressure engine, or of the uncondensed vapor, in a condensing engine,) the surplus power beyond these useless resistances being alone available for the purposes to which the engine is applied.

But in driving machinery, so great a uniformity of motion is essential, that any great variation in the moving power throughout the stroke of the engine is inadmissible, as the fly-wheel would not be able to absorb enough of the excess of power to equalize the velocity sufficiently, by giving it out again at the deficient part of the stroke; consequently, though two engines are often employed working at right angles to each other, for the purpose of diminishing the variation in total moving power, the expansion principle can only be carried to a portion of the extent to which it is theoretically applicable.

Only in such engines as the large Cornish pumping engines can the expansion be carried practically to its full theoretical limit, as the variation in the velocity of the load moved is of much less importance in those engines, and the very unequal amounts of moving power that are developed in equal times, by the full carrying out of the expansive principle, which would produce the most prejudicial and inadmissible variations of velocity in the engine, are controlled within prescribed limits by the great weight of material to be moved by the engine in the pump rods and balancing machinery, forming, as it were, a distributing reservoir for the moving force developed.

In the locomotive engine there are practical difficulties in carrying out the expansion principle efficiently, beyond a moderate extent, in a single cylinder, from the shortness of stroke, and rapidity of reciprocation, and

* From the London Artizan, for March, 1852.

the construction of the valve motion; but the ultimate extent to which it could be carried would be limited by the maintenance of the blast, which requires that the jets of steam discharged from the cylinder into the blast pipe, should not be reduced below a certain pressure at the moment of discharge. Otherwise, the limit to which expansion might be carried would be the resistance of the atmosphere to the discharge of the steam, added to the friction of the engine, say above 10 lbs. per inch above the atmosphere.

The steam is cut off usually by the link motion at from one-third to two-thirds of the stroke, and the steam is consequently discharged into the blast-pipe at about from 30 to 60 lbs. pressure above the atmosphere, supposing it to be supplied to the cylinders at 100 lbs. per inch above the atmosphere.

It appears that the lower of these pressures is sufficient, or more than sufficient for the purposes of the blast, to maintain fully the evaporative power of the boiler under general circumstances, and that a portion of the steam discharged can be spared from the blast, to be subjected to a greater extent of expansion.

In the continuous expansion engine, the subject of the present paper, the steam from the boiler is supplied only to one cylinder; a portion of it is expanded into the second cylinder, which is of proportionately larger area, so as to equalize the total moving power of the two cylinders; and it is there further expanded down to the fullest useful extent, and then discharged into the atmosphere, the portion of steam remaining in the first cylinder being discharged as a blast at nearly the same pressure as the ordinary engines. The economy, therefore, consists in obtaining from such portion of the steam as can be spared from the blast, the additional power of expansion remaining in it, which is thrown away in the ordinary engine.

Fig. 1.

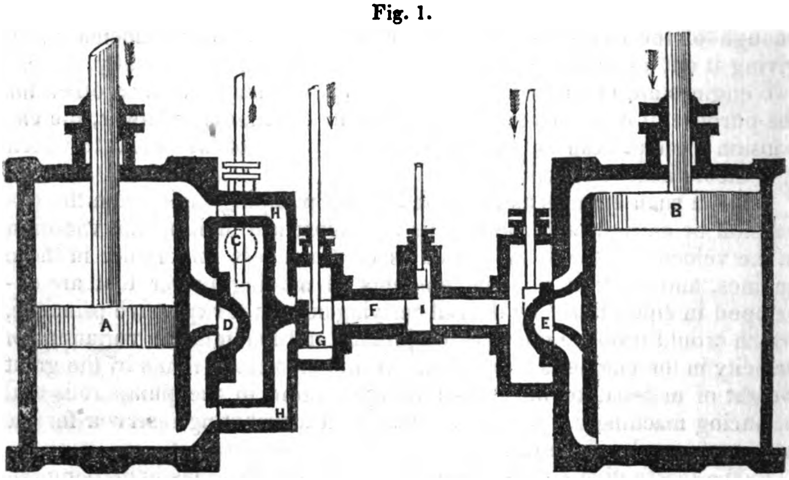


Fig. 1, shows the continuous expansion engine, as applied to a locomotive. A is the first cylinder into which the steam is admitted from the steam pipe, C, by the valve, D, in the same manner as in the ordinary

engines. The steam is cut off at half stroke, and a communication is then opened with a second cylinder, B, through the passages, H and F, by the opening of the slide valve, G. The second cylinder, B, is about double the area of the first cylinder, and the same length of stroke, but the cranks are set at right angles, as in ordinary locomotives; consequently, at the moment of the steam being passed into the second cylinder from the first, the piston of the second cylinder is at the commencement of its stroke.

The steam continues expanding in the two cylinders, until the first piston, A, has nearly completed its stroke, when the valve, G, shuts off the communication between the two cylinders, and the valve, D, opens the exhaust port, and communicates with the blast pipe, L, discharging the steam remaining in the cylinder, A, to form the blast in the ordinary manner. The second piston, B, has then arrived nearly at half stroke, and contains nearly one-half of the total quantity of steam originally admitted to the first cylinder; this steam is further expanded to the end of the stroke, and then discharged into the blast pipe, L, by the valve, E, opening the exhaust port.

The return stroke of both pistons is exactly similar to the foregoing, so that about a half cylinder full of high pressure steam (or such other portion as may be desired) is supplied to the first cylinder at each stroke, and between one-half and two-thirds of that steam is discharged at the pressure required to produce the blast, and the remainder of the steam is expanded down in the second cylinder, so as to give out all the available power remaining in it.

For the purpose of enabling the engine to exert an increased power, if required, at the time of starting a train or otherwise, the slide valve, I, is inserted in the centre passage, F, to close the communication between the two cylinders for a short time when required; and the steam from the boiler is then admitted by a pipe and cock into the steam chest of the second cylinder, B, which is then worked independently of the other cylinder, like an ordinary engine.

The comparative quantity of steam or of coke required to perform the same work in the several engines, under the circumstances stated above, is given by calculation as follows:

| | |
|---|---|
| Continuous expansion engine, . . | 100 |
| Ordinary engine, cutting off at $\frac{1}{3}$rd stroke, . | 120 |
| " " " $\frac{1}{2}$ stroke, . | 154 |
| " " " $\frac{2}{3}$rds stroke, . | 185 |
| " " " $\frac{7}{8}$ths stroke, . | 220 |

These figures represent the relative economy in the employment of the steam in the several engines; consequently, the ordinary engine, with the best degree of expansion, or cutting off the steam at one-third the stroke, consumes 20 per cent. more coke than the continuous expansion engine, to do the same work, and from 54 to 85 per cent. more coke with the more usual degrees of expansion; and an engine cutting off the steam at only one-eighth of the stroke from the termination, as many engines were formerly made, would consume 120 per cent. more coke to do the same work.

This plan has been tried upon two locomotives with satisfactory results, and the blast was found to be quite sufficient; but the trial has not been sufficiently complete to afford a definite comparison of consumption.

In the application of the expansion principle to stationary engines, it is requisite to consider the amount of variation in the moving power or laboring force of the engine, and the limits within which it is necessary practically to confine this variation. The accompanying diagrams show the variation in the moving power that takes place between the commencement and the end of the stroke in each of the several engines, all drawn to the same scale and on the same principle, so that the comparison of the diagrams will show the relative effect of the steam in the several engines; the same total power being represented in each case.

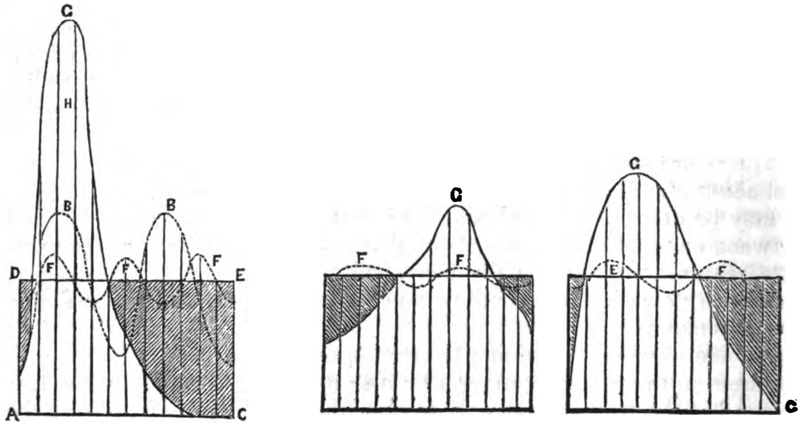


Fig. 3. Fig. 4. Fig. 5.

Fig. 3 shows the variation of power in the Cornish engine, when the steam is expanded down to the limit of useful effect; this is shown by the curved line, A G C. The vertical height of the first division, A D, represents the relative total moving force developed by the engine, in the direction of the revolution of the crank-pin, during the first 15° of revolution from the commencement of the stroke. The heights of the succeeding divisions in fig. 3 represent the corresponding amounts of force developed by the engine during each successive motion of the crank through equal angles of 15° each to the end of the stroke, C, and the half revolution of 180°; the force shown being in all cases the amount that would be produced in the circular direction of the revolution of the crank pin, not in the rectilinear direction of the piston. If the amounts of force in these several divisions were all exactly *equal to one another*, (and the engine, having attained its state of uniform velocity, were employed to overcome a constant resistance to circular motion, such as driving a corn mill or spinning mill, &c.,) then the crank arm would have a perfectly unvarying velocity, and no fly-wheel would be required. And the approach to this constancy of velocity, in any engine applied to overcome resistances to circular motion, will clearly depend on the approach to equality which these amounts of work produced through equal angles make to one another.

The average line, D E, shows this average equal height of all the several divisions; consequently the rectangle, A C E D, represents the equivalent uniform development of power that would produce an unvarying velocity of rotation, and therefore the area of the shaded space, being the deficiency in filling up this rectangle of uniform power by the actual working of the engine, (also equal to the portion H of the curved figure that is above the average line, D E,) will represent the total amount of variation from the average in the moving force of the engine throughout the stroke. The area of the shaded portion in this diagram is 43 per cent. of the total area, consequently the *total variation* from the average in the moving power of the Cornish engine is 43 *per cent.*, and the *greatest variation* at the extreme point G, amounts to 189 *per cent.* of the mean power.

| | |
|---|---|
| The total variation from the average power, | 43 pr. ct. |
| The extreme variation, | 189 " |

Fig. 4 shows in a corresponding manner the variation of moving power throughout the stroke in the continuous expansion engine, where the steam is cut off at half stroke in the first cylinder, and expanded in the larger cylinder down to the limit of useful effect.

| | |
|---|---|
| The total variation from the average power is only | 13 pr. ct. |
| The extreme variation, | 55 " |

Consequently the *total variation* in the moving power in the Cornish engine is 3⅓ times as great as that in the continuous expansion engine, and the extreme variation is 3½ times as great.

The dotted line, B B, in fig. 3, shows the effect of coupling together two Cornish engines, exactly similar to that shown by the full line in fig. 3, but of half the total power each.

| | |
|---|---|
| The total variation from the average power is | 20 pr. ct. |
| The extreme variation | 58 " |

The total variation in the moving power being 1½ times as great as in the continuous expansion engine, and the extreme variation about equal. This arrangement would of course be much more expensive than the continuous expansion engine, as it involves two complete engines.

Fig. 5 shows the variation of moving power in a Woolf's double cylinder engine, where the pistons work simultaneously in the two cylinders, commencing each stroke together, and the steam is cut off at half stroke in the first cylinder, and afterwards expanded in the larger cylinder down to the limit of useful effect, as in the foregoing Cornish engine.

| | |
|---|---|
| The total variation from the average power is | 27 pr. ct. |
| The extreme variation, | 90 " |

Consequently the total variation in the moving power is 2 times as great as in the continuous expansion engine, and the extreme variation 1¾ times as great.

The dotted line, F F, on fig. 4, shows the effect of coupling together two of the continuous expansion engines at right angles to each other, and the result of this arrangement is a remarkably near approach to perfect uniformity of moving power.

| | |
|---|---|
| The total variation from the average power is only | 3 pr. ct. |
| The extreme variation, | 8 " |

The dotted line, F F, on fig. 3, shows in a similar manner the effect of

coupling together three of the Cornish engines, with cranks at 120° to each other.

| | |
|---|---|
| The total variation from the average power is | 9 pr. ct. |
| The extreme variation, | 22 " |

Both being about three times as great as in the continuous expansion engine.

Fig. 5 shows also by the dotted line, F F, the effect of coupling together two of the Woolf's engines at right angles to each other.

| | |
|---|---|
| The total variation from the average power is | 5 pr. ct. |
| The extreme variation, | 13 " |

Both being about 1½ times as great as in the continuous expansion engine.

The comparative amount of work performed by the several engines, with the same quantity of steam or of coal in each case, under the circumstances stated above, and taking the pressure of the steam admitted to the first cylinder at 50 lbs. per inch above the atmosphere, is given by calculation as follows:—

| | |
|---|---|
| Continuous expansion engine, . . . | 100 |
| Woolf's engine, . . . . . . | 109 |
| Cornish engine, . . . . . | 111 |

The general result of the above comparisons is, that the *Cornish engine is* 11 *per cent.*, and *Woolf's engine is* 9 *per cent. more economical* in expenditure of fuel than the *continuous expansion engine*, when the expansion of the steam is carried to the *extreme limit* in each case; but that this economy cannot be obtained practically in those two engines, on account of the great irregularity in their moving power, the *average irregularity* being, in the *Cornish engine* 30 *per cent.*, and in *Woolf's engine* 14 *per cent. greater* than in the continuous expansion engine; and the *extreme irregularity* being 134 *and* 35 *per cent.* respectively *greater*.

Consequently, it appears that, although the expansion of the steam cannot be theoretically carried to so great an extent in the continuous expansion engine as in the other engines, yet, from the moving power being so much more uniform throughout the stroke, the expansion can be carried *practically* to a considerably greater extent; and a greater amount of economy may be practically obtained within the same limit of uniformity in the moving power.

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## *Hints on the Principles which should regulate the Forms of Boats and Ships; derived from original Experiments. By* Mr. William Bland, *of Sittingbourne, Kent.**

Continued from page 49.

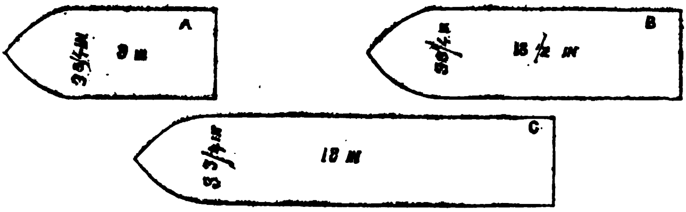
### Chapter IX.—Of the Middle Length of a Ship.

The following experiments were undertaken to ascertain the properties of the middle length, or centre body of a ship. Three models having parallel sides, flat bottoms, the same form of bows, and all of the same breadth of beam, namely, 3¾ inches; yet varying in their lengths as fol-

* From the London Architect for September, 1851.

lows, but all of equal weight: length of A, 9 inches; B, 13½ inches; C, 18 inches.

Scale, ⅛th inch to 1 inch. Weight of each 20 oz.

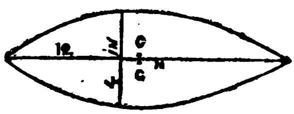



This difference in their respective lengths was made for the purpose of ascertaining the effects of increased length, with regard to speed, and the power of carrying weight.

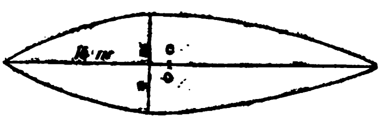
*Experiment* 37.—The model, A, was tested by the balance rod, with B, and which beat in speed, A, so as to require the weight of 8 oz, to be put into B, to retard its speed to that of A.

*Experiment* 38.—B, being tested with C, C required the weight of 8 oz. to be put into it, to cause the speed to equal B, being the same difference as in the first experiment; and, therefore, the speed of C will equal the speed of A, and carry at the same time, 16 oz. additional weight.

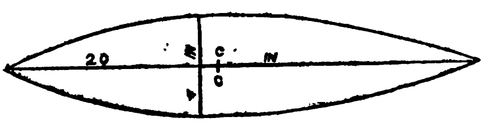
The same law exists in models of a different form, and is instanced in the following experiments. Three models were tested against each other to discover the difference in their speed, having level bottoms, of the same weight and breadth of beam, but varying in their lengths; scale, ⅛-th inch to 1 inch.



No. 1.—Weight, 22½ oz.; thickness, 2 inches.



No. 2.—Weight, 22½ oz.; thickness, 2 inches.



No. 3.—Weight, 22½ oz.; thickness, 2 inches.

*Experiment* 39.—No. 1 was so far inferior in speed to No. 2, that the extra weight of 12 oz. was put into No. 2 before its speed was retarded to the same rate of speed as No. 1.

*Experiment* 40.—Now, No. 3 beat in speed, No. 2, as to require 12 oz. to be placed in No. 3, to bring their speed to an equality.

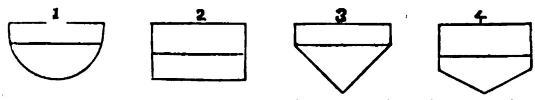
The inference to be drawn from the foregoing experiments is, that additional length gives increase of speed; or will carry the weight through

the water with proportional less resistance. The stability, likewise, increases with equal ratio, as given in experiment 7. The cause of this less resistance must arise, in the first instance, from the same dimensions of bows and breadth of beam clearing the way for the increased length of the after part; and, in the second, in consequence of the increased length, which is followed by increased surface bearing; therefore, the whole weight displaces less depth of water—hence arises less resistance when the length alone is concerned. With respect to the increase of the breadth of beam improving speed, the cause proceeds from the curves and the enlarged surface bearing combined; otherwise, the result of the experiments (Nos. 1 and 2, &c.,) would have decided contrary.

### Chapter X.—Form of the Midship Section.

This chapter relates to the form of the midship section; its importance as to a ship's speed, and to determine which the experiments, as detailed in the subsequent pages, were resorted to.

Four models, all of the length of 14 inches, and 4 inches wide, having their sides parallel and bottoms level, of equal weight, namely, 30¾ oz., but the midship section of each varying as represented in the diagrams, were tested one with the other; first, to ascertain their speed; next, their stability; third, their lee way; lastly, their burden or floating depth.




Midship Sections; Scale, ⅛-th inch to 1 inch. The dotted line is the float line.

The comparative velocities, as denoted by the balance rod, were as follows:

*Experiment* 41.—No. 1 beat in speed No. 2 by 2 oz., that extra weight being required in No. 1, to retard its speed till it equalled that of No. 2.

*Experiment* 42.—The speed of Nos. 2 and 3 proved equal.

*Experiment* 43.—The speed of No. 4 was the worst of them all, since it required 4 oz. extra weight to be put into No. 1, with which it was tested, before its speed equalled that of No. 4.

The inference to be drawn from the experiments is, that the curve gives greater speed than straight lines with angles. When the bottom of No. 4 had its angles cut off so as to form an ellipse, its speed was in consequence so far improved, that 2 oz. in No. 1 were sufficient; or the velocity of No. 4 became equal to Nos. 2 and 3.

Of the stability and floating depth of the above four models,—

| | | |
|---|---|---|
| No. 2. | Stability equalled 3½ oz. | Floating depth 1½ inch. |
| No. 4. | Stability equalled 3 oz. | Floating depth 1¼ inch. |
| No. 1. | Stability equalled 2¼ oz. | Floating depth 1⅜ inch. |
| No. 3. | Stability equalled 1¾ oz. | Floating depth 2 inches. |
| No. 4. | Ellipse equalled 3 oz. | Floating depth 1¼ inch. |

Here we have No. 2 possessing the greatest stability, and No. 3 the least, both being of the same speed. And again, No. 2 draws but 1 inch of water, whereas, No. 3 draws 2 inches, or double, though of equal weight.

(To be Continued.)

For the Journal of the Franklin Institute.

## *On the Telegraphic Lines of the World.* *By* Dr. L. Turnbull.

Continued from page 45.

### United States.

The following is a more correct list of the Telegraph Companies in the United States, obtained since the publication of my list in the July number of this *Journal:—*

New York and Boston Magnetic Telegraph Company, from N. York to Boston, about 250 miles; three wires, one passing through Providence, R. Island, the other through Springfield, Mass., using the Morse patent.

Merchant's Telegraph Company, from New York to Boston, about 250 miles; two wires passing through Providence, using Bain's patent.

House's Printing Telegraph, from N. York to Boston, 250 miles; one wire, uses House's patent.

Boston and Portland Telegraph Company, from Boston to Portland, 100 miles; one wire, using Morse's patent.

The Merchant's Telegraph Company have one wire from Boston to Portland, 100 miles; Bain's patent.

Maine Telegraph Company, from Portland to Calais, Maine, about 350 miles; one wire; Morse's patent.

St. Johns and Halifax line, from Calais to Halifax, about 400 miles; one wire; Morse's patent.

There is a line of Bain Telegraph from Boston through N. Hampshire to Burlington, Vt., thence to Ogdensburg, New York; about 350 miles; one wire.

New York, Albany, and Buffalo line, from N. York to Buffalo, through Albany and Troy; 513 miles long; three wires, using Morse's patent.

New York State Telegraph Company, from N. York to Buffalo, via Albany, two wires; 550 miles long, with a branch from Syracuse to Ogdensburgh, via Oswego; about 150 miles; one wire: also a branch from Troy to Saratoga, 36 miles; one wire; use Bain's patent. There is also a Morse line from Syracuse to Oswego, about 40 miles.

House Telegraph Company, from N. York to Buffalo, via Albany, 550 miles; two wires; use House's patent.

New York and Erie Telegraph, from New York to Dunkirk, via Newburgh, Binghamton, and Ithaca; 440 miles, one wire; Morse's patent.

New York and Erie Railroad Telegraph, for Railroad use, along the line of N. York and Erie Railroad, 460 miles; Morse's patent.

Magnetic Telegraph Company, from New York to Washington, via Philadelphia; seven wires, 260 miles; Morse's patent.

House Line from New York to Philadelphia, 100 miles, one wire; House's patent.

Troy and Canada Junction Telegraph Company, from Troy to Montreal, through Burlington, Vt., 260 miles; one wire; Morse's patent.

Erie and Michigan Telegraph Company, from Buffalo to Milwaukie, via Cleveland, Detroit, and Chicago; one wire all the way; second wire from Buffalo to Cleveland; 800 miles long; Morse's patent.

Cleveland and Cincinnati Telegraph Company, from Cleveland to Cincinnati; 250 miles long; two wires; Morse's patent.

Cincinnati to St. Louis, via Indianapolis, 400 miles long; one wire; Morse's patent.

Cleveland and Pittsburg Telegraph Company, from Cleveland to Pittsburg, 150 miles, one wire; Morse's patent.

Cleveland and Zanesville Line, from Cleveland to Zanesville, 150 miles; one wire; Morse's patent.

Lake Erie Telegraph Company, from Buffalo to Detroit, via Cleveland, 400 miles; one wire; Morse's instrument built under O'Reilly's contract with Morse, with branch from Cleveland to Pittsburg, 150 miles; one wire.

Cincinnati and Sandusky City Line, about 200 miles; one wire; Morse's patent.

Toledo to Terra Haute, via Forte Wayne, about 300 miles; one wire; Morse's patent.

Chicago to Dayton, one wire; Morse's line.

Chicago to St. Louis, via Peoria, about 400 miles; one wire; Morse's patent.

Milwaukie to Greenbay; 200 miles; one wire; Morse's patent.

Milwaukie to Galena, via Madison, about 250 miles; one wire; Morse's patent.

Chicago to Janesville; one wire; Morse's patent.

Buffalo and Canada Junction Telegraph Company, from Buffalo to Lamiston; one wire, connecting with a wire in Canada that runs to Toronto, about 200 miles.

Montreal Telegraph Company, from Toronto to Quebec, via Montreal, 600 miles; one wire; Morse's patent.

Montreal to By Town; one wire; Morse's line.

Having received later information in regard to some of the lines, I would make the following corrections to my article in the July number:

No. 2. "Atlantic and Ohio Telegraph Line" is so referred to as to convey the impression that it ran from Philadelphia to Milwaukie: this is not the case; the line belonging to that company runs from Philadelphia to Pittsburg. The Lake Erie Telegraph Company have a line from Buffalo to Detroit, with a branch from Cleveland to Pittsburg.

No. 4. The New York, Albany, and Buffalo Telegraph, extends from N. York to Buffalo, via Albany and Troy, 513 miles long, having eighteen stations between Buffalo and New York; connecting at Troy with Troy and Canada Junction Telegraph Company; at Syracuse with Syracuse and Oswego Telegraph Company; at Canandaigua with a line from Canandaigua to Jefferson, N. York; at Rochester with a line from Rochester to Dansville, N. York; at Buffalo with Buffalo and Canada Junction Telegraph Company, and with Erie and Michigan Telegraph Company; the latter extending from Buffalo to Milwaukie, via Cleveland, Detroit, and Chicago, 800 miles.

No. 6. There are three companies, if not four, owning the line from Boston to Halifax; from Boston to Portland there are two lines, one using the Morse instrument, and one the Bain instrument; from Portland to Calais,

Maine, one company, using the Morse instrument; from Calais to Halifax, the Morse instrument is used; the line in each province is owned by separate companies, organized under charters from their respective legislatures.

No. 7. The New York and Boston Morse line extends from New York to Boston; to reach Halifax it connects at Boston with lines in No. 6. "Also from N. York via Bridgeport to Birmingham, Connecticut, with eleven stations; there is no such line; there is a branch from New Haven to Waterbury, Conn.; there is no intermediate station.

"In April, 1852, direct communication was had between the N. Orleans Telegraph Office, and the Office of the New Orleans line, in Hanover St., N. York; the whole extent of near 3000 miles of wire having been successfully worked in one circuit."

The entire length of the line from New York to New Orleans, via Charleston, Savannah, and Mobile, is 1966 miles; and this distance was not worked in one circuit, nor can it be with either of the existing systems with the best mode of insulating in use. The instance of direct communication was secured by dividing the line into several circuits, probably five or six, and connecting those circuits through the agency of an instrument termed a connector, the effect of which is to cause one circuit to work the other through the entire series, thus producing a result similar to working through the entire line in one circuit. The connector is an instrument first invented and applied by E. Cornell, Esq., of N. York, on the N. York, Albany, and Buffalo line, at Auburn N. York, to work a branch line from Auburn to Ithaca, for the purpose of taking news reports at Ithaca; at the same time the wire being transmitted from N. York to Buffalo on the main line; this was adopted in the year 1846; it was found to work admirably, and he afterwards modified it so as to make it applicable to working both ways in a main line, or in other words, to make it capable of working a number of series of circuits in a main line; the instrument was adopted for this purpose on the N. York and Erie, and Erie and Michigan lines, in the year 1849, and has been in constant use ever since; by it they having frequently worked direct from N. York to Milwaukie, 1300 miles. The instrument used on the New Orleans line, which was described in my Lectures on the Telegraph, was adopted by Mr. Chas. Bulkley, the then superintendant of the line, who claims it as his invention, made in 1850 or 1851.

The greatest distance that Mr. Cornell has known any lines to work in *one* circuit, was from Boston to Montreal, via N. York, Buffalo and Toronto, a distance of about 1500 miles; this, however, was done when the earth was frozen, and the lines thus insulated by the frost much better than man has yet contrived to insulate them without its aid. There are no lines working succesfully in *one* circuit more than 550 miles; lines may be so insulated as to work in one circuit under states of the atmosphere from 8 to 1000 miles.

"The Atlantic and Pacific range, under the arrangement of Henry O'Reilly, Esq.; using a modification of Bain's Chemical Telegraph and Morse's instrument, from N. York to Washington, and N. York to Boston,

&c., &c." Mr. O'Reilly has nothing to do with either of those lines; he was contractor for building one of them, but has no interest in them, and no control over them. The lines in the west are owned by separate independent companies, over which he has no control. The line from St. Louis to Fort Leavenworth, O'Reilly has nothing to do with; it has been built by other parties in direct opposition to all of O'Reilly's movements.

The Bain Lines in the United States are as follows: "One from New York to Boston, two wires; one from N. York to Buffalo, two wires.

In the list of lines, there are No. 2, from Washington to New York, via Baltimore and Philadelphia, 5 wires, 250 miles each, 1250 miles; at No. 8, Philadelphia to New York, 6 lines, 120 miles each, 720 milès." Those are the same lines each, and they have been duplicated. Including the Bain and House lines, there are only 8 wires between New York and Philadelphia; the 9th one is now being put up by the Magnetic Telegraph Company.

No. 15. Bridgeport and Birmington line has not been in use for two years; is taken down.

No. 22. Troy to Whitehall, via Salem, not been at work for more than a year.

No. 25. Auburn to Elmira, via Ithaca, taken down more than a year ago.

No. 26. Binghamton to Ithaca, via Owego, is a part of the N. York and Erie line mentioned at No. 14, from New York to Fredonia.

No. 31. Cleveland to Pittsburg, via Alton, Illinois; this is an error, as Pittsburg is in Pennsylvania, east of Cleveland, and Alton is in Illinois, west of Cleveland more than 500 miles.

No. 33. *No such line as* from Pittsburg to Columbus, 680 miles; No. 34. No such line as this; there is a line from Columbus, Ohio, to Portsmouth, Ohio, about 100 miles.

No. 37. Columbia to Chilicothe is the same line as referred to above, No. 34.

There is not over 2200 miles of House wire up. "The 6000 miles of O'Reilly lines" are, to a great extent, embraced in the 17,283 Morse lines, and also embraced in the 1092 miles of Bain's line.

There is an "Erie and Allegheny Telegraph Company," having a line from Dunkirk, N. York, via Warren, Pa., thence to New Castle, Pa., and thence to Pittsburg.

*Consolidation of Telegraphs.*—We learn from the Cincinnati papers, that all the leading Telegraph lines in the West, and South, and Northwest have been united in business interests. The N. Orleans and Ohio line, extending from N. Orleans to Pittsburg; the People's line from N. Orleans to Louisville; the two wires, Louisville, Cincinnati, and Pittsburg line, and the Western line from Wheeling and Pittsburg to Baltimore and Washington city, are all direct parties to the contract—securing these arrangements.

The union brings the Morse and O'Reilly offices in Cincinnati and all other cities on the lines named together. In Cincinnati the Morse lines are removed to the O'Reilly office, which will hereafter be known as the *National Telegraph Office.*

The lines connected directly by this union, connect also indirectly with wires extending over thousands of miles, and embracing within their

iron arms almost every city and large town in the United States. Perhaps there are no lines of equal extent in the world, or working together with equal harmony, as those radiating from the National Telegraph Office in Cincinnati. They are seventeen in number, and embrace in all *ten thousand eight hundred and twenty-four miles of wire.*

The following report of the Cincinnati and Louisville Telegraph Company for 1850 and 1851, exhibits great enterprise, and the value of the telegraph as a mercantile investment in America. It appears that during the preceding year, three dividends of three per cent. each had been paid, and one quarter's dividend retained for rebuilding the line. The whole sum expended for repairs up to June 1851, amounted to $10,405·94. With this sum, 83 miles of poles have been reset, 146 miles put in repair, and 156 miles renewed. The receipts during the year 1850, were as follows:

| *Receipts.* | | *Expenditures.* | |
|---|---|---|---|
| Louisville, | $22,000·08 | Fuel, Gas-Light, Candles, &c., | $ 642·42 |
| Madison, | 2,155·99 | Rent of Offices, Bridges, &c., | 1,558·70 |
| Laurenceburgh, | 192·60 | Stationery of all kinds, | 1,253·61 |
| Cincinnati, | 18,470·97 | Salaries, | 18,115·39 |
| Dayton, | 2,727·55 | Refunded for despatches failing delivery, | 619·86 |
| Springfield, | 631·37 | Repairs of the Line, | 7,663·30 |
| Columbus | 3,403·49 | Cost of Batteries, | 734·25 |
| Janesville, | 1,628·36 | Miscellaneous | 4,425·64 |
| Mt. Washington, | 72·37 | | |
| Wheeling, | 2,525·71 | Total, | 35,013·67 |
| Steubenville, | 878·08 | | |
| Pittsburgh, | 17,992·17 | | |
| Total, | 73,278·72 | | |

*Recapitulation.*

| | | |
|---|---|---|
| Total Receipts for 1850, | | $73,270·72 |
| Paid to connecting lines, | 24,788·45 | |
| Expenditures, | 35,013·57 | 59,802·90 |
| Total Residue, | | 13,476·72 |

Statistics of the year 1850: Number of words transmitted, 3,602,760; number of despatches recorded, 364,559. These are exclusive of free matter, necessarily large at all times. Average hours of labor, fourteen per day. The record of despatches for 1850, on the paper of the registering instrument, covers a length of 1704½ miles: number of hands employed, 58.

### *The Law of Telegraph in the U. States.—An Act Relating to the Commencement of Actions, &c., Relative to Penalties on Telegraphic Operators, &c.*

Sec. 7. That from and after the passage of this act, it shall not be lawful for any person connected with any line of telegraph within this Commonwealth, whether as superintendent, operator, or in any other capacity whatever, to use, or cause to be used, or make known, or cause to be made known, the contents of any despatch of whatsoever nature, which may be sent or received over any line of telegraph in this Commonwealth, without the consent or direction of either the party sending or receiving the same—and all despatches which may be filed at any office in this Commonwealth, for transmission to any point, shall be so trans-

mitted without being made public, or their purport in any manner divulged at any intermediate point, on any pretence whatever, and in all respects the same inviolable secrecy, safe keeping, and conveyance, shall be maintained by the officers and agents employed upon the several telegraph lines of this Commonwealth, in relation to all despatches which may be sent or received, as is now enjoined by the laws of the United States in reference to the ordinary mail service: *Provided*, That nothing in this act contained, shall be so construed, as to prevent the publication at any point of any despatch of a public nature, which may be sent by any person or persons with a view to general publicity.

Sec. 8. That in case any person, superintendent, operator, or who may be in any other capacity connected with any telegraph line in this Commonwealth, shall use, or cause to be used, or make known, or cause to be made known, the contents of any despatch sent from or received at any office in this Commonwealth, or in anywise unlawfully expose another's business or secrets, or in anywise impair the value of any correspondence sent or received, such person being duly convicted thereof, shall, for every such offence, be subject to a fine of not less than one hundred dollars, or imprisonment not exceeding six months, or both, according to the circumstances and aggravation of the offence.

Approved April 14, 1851.

(To be Continued.)

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Translated for the Journal of the Franklin Institute.

## *Note on Galvanic Silvering.* By MM. E. Thomas and V. Dellisse.

The beautiful investigations of MM. de Ruolz and Elkington, have proved that it is not all the solutions of the salts of silver that give, by the aid of the battery, a constant and adherent layer of metallic silver: that this property is limited to certain special solutions, whose characters appeared to be thus defined:

1st, That the liquid conducts the electricity sufficiently:

2d, That under the influence of the electric current, nothing but silver is deposited.

3d, That the liquid does not attack the metal to be covered.

4th, That the liquid has an alkaline reaction. To these four conditions M. Bouilhet has just added a fifth, which, according to him, is indispensable; that is, that the liquid shall contain a double salt of silver, and a fixed alkali, which in separating, gives rise to the silvering.

There are but two series of solutions which answer these conditions:

1st, The solutions of silver in alkaline cyanides, which are the only ones which heretofore have given results which are constant, and in all respects satisfactory.

2d, The solutions of silver in the alkaline hyposulphite of soda and potassa, which give, indeed, indications of silvering, but shew such variations in the thickness and adhesion of the silver deposited, that notwithstanding their lower price, it has not been possible to substitute these hyposulphites for the alkaline cyanides.

The salts having ammonia for their base, several of which dissolve the oxide of silver easily and in great quantity, are not, according to M.

Elkington, fitted to give solutions capable of silvering. It is, nevertheless, upon this series of compounds that we directed our examinations.

And in the first place, we satisfied ourselves that no salt of ammonia, neutral or alkaline, holding the oxide of silver in solution in water, could deposit metallic silver in a constant and adherent layer; the ammonia coming to the negative pole to destroy the deposit which tends to form there, and attack the metal to be covered.

We had a commencement of success, by employing alcohol as a vehicle, and saturating it with nitrate of ammonia, to make the bath a conductor, then dissolving in it the double nitrate of silver and ammonia, as neutral as possible. But, although this bath gave a thick and adherent silvering, it was subject to too many opposing accidents. The too great alkalinity of the liquid, the lowering of the temperature, the presence of the least trace of chlorides, prevented us from obtaining good results, besides which, the expenditure of electricity had to be considerable, and the copper to receive the deposit of silver must be first covered with a pellicle of that metal by the operation of whitening.

We were then led to remark that the silvering depended essentially on the reducing property of the bath, and a great number of experiments showed us that although alkalinity was a necessary character in the usual baths, it was an absolute obstacle in the case of the employment of the ammoniacal salts; that far from the acidity of the bath being hurtful, it was indispensable in the same case, provided it was due to an acid greedy of oxygen, and not attacking copper strongly.

We will here remind, that we did not seek to determine the phenomena in silvering by the cyanides, but only the conditions under which it is possible to deposit metallic silver on copper, using solutions of salts of ammonia.

A sealed package deposited by us in the session of the 23d Feb., contains a series of experiments made on this subject, but as we do not yet ask for its opening, because it also contains other researches which we have not yet concluded, we will briefly retrace here our principal experiments:

1st, Whatever may be the solution of silver in a salt of ammonia upon which we operate, it cannot give a constant and adhesive coat of silver unless it contains a free acid, greedy of oxygen, such as the phosphorous, sulphurous, hypophosphorous, and hyposulphurous acids. Thus the neutral or alkaline sulphite of ammonia does not give good silvering; but it gives it immediately when it is made decidedly acid with an acid greedy of oxygen.

2d, All the acids greedy of oxygen do not succeed; this is the case with nitrous acid, probably because it has too much affinity for the metal to be covered.

3d, All the solutions of salts of ammonia capable of dissolving the oxide of silver do not succeed; the solution of silver must, besides, be stable: thus the acid sulphite of ammonia, at first silvers, but soon decomposes rapidly, under the action of the battery, and the silver is almost entirely precipitated from it. But if, to the solution of acid sulphite of ammonia, we add the hyposulphite of ammonia, it becomes capable of furnishing a more stable bath of silver and one which gives better results.

4th, The presence of a double salt of ammonia and silver is not sufficient in order that the bath may silver; in fact, the neutral solution of the double nitrate of ammonia and silver does not silver; it gives indications of good silvering, if we saturate it with sulphurous acid. The same is the case with the double sulphite, except the stability of the bath, and *à fortiori*, the same is the case with the double hyposulphite.

5th, The presence of a double salt of silver and any alkali, is not a necessary condition for the silvering by the bath; in fact, the sub-citrate of silver, as M. Regnault showed, prepared by passing hydrogen over the proto-citrate, (precipitated cold, so that no aconitic acid may be found,) gives a solution which silvers well, but which is decomposed during use, which property does not permit it to be employed. The nitrate of silver also gives at first a good silvering, but one upon which the affinity of the nitrous acid for copper, soon exercises an influence.

6th, It appears to us, that in the baths which we have tried, the salt of ammonia has no other utility than to keep the silver in solution, while the property of silvering is entirely due to the presence of a free acid, greedy of oxygen. In fact, this acid acts only by disguising the ammonia without attacking the copper, for if the bath is acidified by sulphuric acid, no silvering is produced. Nevertheless, it may be seen by shaking well cleaned copper turnings with dilute sulphuric acid, that the metal is not sensibly attacked, while the sulphurous acid in the same conditions, attacks it very sensibly.

7th, In the baths which we tried, a platina anode gives better results than one of silver. In fact, the silver anode, either in these baths or in those of cyanide, does not dissolve in proportion to the silver deposited at the kathode; besides, a notable proportion of the silver of the anode is attacked, and precipitated as a sub-salt. Only, in the cyanide baths, it is necessary to employ the soluble anode, to avoid the disengagement of hydrocyanic acid, whilst the disengagement of sulphurous or hyposulphurous acid presents no inconveniences.

8th, To get adherence, the cleaning of the pieces to be silvered must vary according to the reaction of the bath; cleaning by acids gives adherence only in acid baths; it, on the contrary, destroys the adherence in the alkaline baths; this is perhaps caused by the difference of the molecular states of the copper when cleaned by pumice and potassa, or by an acid bath.

In fine, the bath which gave us the best results is a mixture at 8° (Baumé) of bisulphite and acid hyposulphite of ammonia, in which has been dissolved the oxide of silver, or an insoluble salt of that base, such as the chloride for instance.

Several distinguished Savans, MM. Dumas, Payen, Peligot, Edm. Becquerel, have already done us the honor of being present at our experiments, and appeared to admit their reality.

This bath, which appears to obey conditions, altogether different from those which have been heretofore laid down, has, moreover, a decided advantage over the cyanide baths, inasmuch as it is altogether inoffensive to the health of those who are using it, a consideration which perhaps may have some value in the eyes of the Academy. The bath is moreover

practically economical, for the salts which compose it are of but little value, and as it conducts electricity very well, it requires much less than the alkaline baths.—*Comptes Rendus de l'Academie des Sciences, (Paris,) 12th April,* 1852.

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Translated for the Journal of the Franklin Institute.

*A New Arrangement of the Voltaic Couple. Note of* M. Fabre de la Grange, *presented by* M. Becquerd.

I have discovered a method of making the current of the voltaic pile, perfectly constant and invariable, even for weeks and months, of whatsoever metals the electrodes may be formed; whether they be put into action by separate liquids, as in the combination of Bunsen, or by a single liquid, as in the arrangement of Volta.

This continuousness of the electric action is obtained, as is that of the heat of a furnace provided below with a grate to let the cinders fall, and continually supplied with combustible from above.

The means which I employ is simple, and fulfils all the conditions which can render it applicable in practice. In place of increasing the expense, it diminishes it.

Let us look first at the arrangement of a single couple with a single liquid. Let there be a vessel having a hole pierced in the middle of its bottom; in this vessel, let there be a concentric diaphragm of sail-cloth, rising not so high as the edge of the vessel, and fixed by cement to the bottom. Within the diaphragm is a cylinder of very dense gas-coke, surrounded by small pieces of the same material, and around the diaphragm a cylinder of amalgamated zinc, and acidulated water, which is supplied drop by drop from above.

Let us now join the poles by a conducting wire, and let us see what passes in the inside of the apparatus. The acidulated water which continues to come drop by drop from above, will pass over the top of the cloth diaphragm upon the charcoal, which will be thus continually washed by the movement of the liquid, without, however, being soaked, so that the polarization will be suspended, and the bubbles of hydrogen will disengage themselves freely from the interstices of the grains; on the other hand, the lower layers of acidulated water will, from the effect of the pressure which they support, filter slowly through the cloth, which the upper and middle layers will not do in any perceptible degree. Now these lower layers are precisely those which contain the sulphate of zinc which is to be eliminated. The result is an electric current, which is entirely constant until the zinc has entirely disappeared, and is obtained without other care than that of supplying the reservoir.

The following is the method in which I unite a large number of couples: the stoneware cups which contain them, being three or four diameters in length, and consequently resembling tubes, are united and cemented into a bundle or block easily carried. The upper surface is horizontal, small gutters lead the acidulated water to each cup. With this disposition, by placing a second reservoir over the pile, and changing the nature and

height of the diaphragms, it is easy to employ a second liquid, which is dropped directly, and drop by drop on the carbon; as for instance, nitric acid. It is used advantageously very weak, and when it can no longer serve for the Bunsen battery, because it no longer absorbs hydrogen.

The liquids, as they come off from the cups, are collected, and may serve again until they are saturated.

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## *On the Decolorizing Property of Charcoal and several other Bodies.* By E. Filhol.*

It is generally stated that charcoal is the only simple body which possesses the property of absorbing coloring matter dissolved in a liquid; it further appears from the investigations of MM. Bussy and Payen, that decoloration by charcoal is a purely physical phenomenon.

Several compound bodies (alumina, sulphate of lead prepared by the moist way, hydrate of lead,) also partake of the property of decolorizing liquids; but it is generally considered by chemists that the action exerted by oxides on coloring matter in the preparation of lakes, is chemical, differing in this respect from that of charcoal; nevertheless, Berzelius was of opinion that the decoloration effected by the oxides and metallic salts resembled that produced by charcoal. My object has been to prove:—

1. That charcoal is not the only simple body possessing the property of decolorizing liquids; sulphur, arsenic, and iron, obtained by the reduction of the hydrated sesquioxide by hydrogen, are all possessed of decolorizing power.

2. That the number of compound bodies having an appreciable decolorizing power, are more numerous than has been thought, and that this power appears to depend much more on the state of division of these bodies than on their chemical properties.

3. That such bodies which easily appropriate one coloring matter may have but little tendency to do so with another; thus phosphate of lime from bones (artificially obtained) scarcely decolorizes the sulphindigotate of soda, whilst it exercises a more energetic influence on tincture of litmus than does animal charcoal.

3. That the decoloration, in the majority of cases, is a purely physical phenomenon; thus the same coloring matter is absorbed by metalloids, metals, acids, bases, salts, and organic substances. It is easy, moreover, by employing suitable solvents, to remove the coloring matter in an unaltered state from the body which had absorbed it.

I do not doubt but that these facts may prove useful in analytical chemistry and in some manufacturing processes.

The following results, which I have extracted from my memoir, will give some idea of the energy with which certain decolorizing matters act.

* From the London Chemical Gazette, April, 1852.

My observations were made with one of Collardeau's double lunette colorimeters:—

*Decolorizing Power of different Substances, compared to that of purified Animal Charcoal, supposed equal to* 100.

| | Tincture of Litmus. | Sulphindigotate of Soda. |
|---|---|---|
| Charcoal, . . . | 100·00 | 100·00 |
| Pure hydrate of iron, . . | 128·90 | 1·97 |
| Alumina, . . . | 116·00 | 9·91 |
| Phosphate of lime, . . . | 109·00 | 1·97 |
| Iron reduced by hydrogen, . | 95·33 | 100·00 |
| Milk of sulphur, . . . | 26·67 | 0·00 |
| Deutoxide of manganese, (native,) | 88·90 | 13·80 |
| Indigo, . . . . | 80·00 | 13·50 |
| Oxide of zinc, . . . | 80·00 | 6·55 |
| Stannic acid, . . . | 70·40 | 0·00 |
| Antimonic acid, . . . | 66·66 | 1·97 |
| Chromate of lead, . . . | 70·40 | 2·92 |
| Litharge, . . . | 66·66 | 3·85 |
| Sulphuret of antimony, (native,) . | 59·25 | 0·00 |
| Sulphate of lead, . . . | 50·00 | 13·80 |
| Deutoxide of copper, . . | 26·67 | 0·00 |
| Protochloride of mercury, . | 22·22 | 0·00 |
| Sulphate of baryta, (artificial,) . | 50·00 | 0·00 |
| Sulphuret of lead, (artificial,) . | 130·00 | 16·67 |

*Comptes Rendus, Feb.* 16, 1852.

## *Ellis' Blooming Rolls.*

Mr. Thomas Ellis, of the Tredegar Iron Works, Monmouthshire, is the inventor of a simple modification of the common machine for rolling blooms or piles of iron, which possesses some very important advantages over the old arrangement. The system on which it operates is, that the rolls are made to rotate first in one direction and then in the other, so as to roll the pile backwards and forwards in the direction of its length, thus forming both ends of the bloom alike.

Fig. 1.

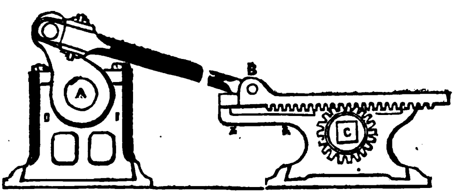


Fig. 2.

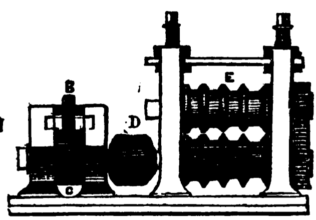


Fig. 1 is an end view of the rolls and actuating crank, the connecting rod of which is represented as broken away. Fig. 2 is a view at right angles to fig. 1, showing the rack and pinion apparatus as divested of the driving crank. The power is communicated by the main shaft, A, constantly revolving, and carrying on its end a powerful crank, to the pin of which is jointed a connecting rod, passing to an eye, B, on one end of a horizontal toothed rack. This rack slides in guides on the top of a pedestal, forming the bearing of a short shaft, having upon it a toothed pinion, C, with which the rack gears. This shaft is coupled at D with the lower of the pair of rolls, E, so that as the shaft, A, revolves, it gives a continuous reciprocatory rotary motion to the pinion, C, and through it to the rolls.

The result of this sytem of rolling is, that the bar of iron is made of uniform quality throughout its entire length, whilst the bloom does not require to be lifted over the top of the rolls, as is the case at present. Hence arises a considerable saving in time and labor—for two men and two boys are able to roll by it five tons per hour, or sixty tons per day of twelve hours, and blooms of from 10 cwt. to a ton can be managed with comparative ease.

The machine has now been rolling for some time at the Tredegar works, and has passed through it upwards of 13,000 tons without accident.

*Remarks.*—The old or present system of rolling, by passing the iron between the rollers and then passing it back over them, and again passing it between them, &c., always presenting the same end of the bar first to the rolls, does *not* "make a bar of iron of uniform quality throughout its entire length," as above stated, because the cinder and impurities which are fluid, are driven backward, or towards that end of the bar which comes last through the rolls; consequently, this end always contains more impurities than the one first presented to the rolls.

The plan of rolling described in the foregoing article, would therefore make a bar of iron of "uniform quality," because the cinder would be driven alternately from one end of the bar toward the other, but not driven *out*, as it is in the plan generally adopted.

When it is desired to make a fine quality of iron, we think this plan would not be found to answer satisfactorily, but where a large quantity of ordinary quality is wanted, it would probably do very well. S.

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## FRANKLIN INSTITUTE.

*Proceedings of the Stated Monthly Meeting, July* 15, 1852.

Owen Evans, Esq., President, *Pro. Tem.*

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations were received from The Royal Astronomical Society, London; Hon. Jos. R. Chandler, M. C.; The Young Men's Mercantile Library Association, Cincinnati, Ohio, and from Messrs. Isaac Lea, Ed. D. Ingraham, R. H. Kern, Dr. L. Turnbull, and George M. Conarroe, Phila.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of May.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Exhibitions reported that they had instructed their chairman to offer premiums for the best designs for a certificate of Third Premium to be awarded at the Exhibitions.

New candidates for membership in the Institute (2) were proposed, and the candidate (1) proposed at the last meeting was duly elected.

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### *Errata.*

Page 46, 13th line from bottom, for "that *position* of the former power," read "that *portion* of the former power."

# JOURNAL

OF

# THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

# PROMOTION OF THE MECHANIC ARTS.

**SEPTEMBER, 1852.**


## CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

*Remarks on the Rifle.* By William N. Jeffers, U. S. N.

The attention of the military and sporting world has been attracted, and its inventive genius stimulated, by the published reports of the extraordinary performances of the needle gun, and Miniè rifle. These reports were supposed to be greatly exaggerated; but a repetition of these experiments under other circumstances, has proved that, although the results were not in all respects such as to warrant an abandonment of arms which have passed the ordeal of service, a weapon constructed on this principle is in most respects superior to that which has for so long a period formed the armament of a portion of the troops of all civilized nations. Notwithstanding these disadvantages, there are persons who consider accuracy preferable to simplicity, and who do not doubt that the rifle, in some of its forms, must ultimately supersede the smooth bore, for warlike, as it already has for sporting purposes. But what are the conditions to be fulfilled in making a perfect rifle? This is a problem of difficult solution; perhaps, by collating some experiments which have been made at various times, by order of different governments, we may be more successful in our endeavors to ascertain in what respects these new arms are superior to the old, and be saved the trouble of experimenting ourselves to ascertain results already known.

In firing a musket or other smooth bored arm, there are two causes which affect the ball most injuriously, and cause it to deviate from the line of aim.

The first cause is, that the ball not being either perfectly spherical or perfectly homogeneous, the centre of gravity does not coincide with the centre of figure; consequently the resistance experienced during its flight is not directly opposed to the motion of the centre of gravity.

The second, that the ball generally has a rotary motion on some axis, produced either in the barrel or after it has left it. *In the barrel*, if the impulse of the powder is not in the direction of the centre of gravity of the ball, (an effect similar to that produced by striking a billiard ball out of line,) or by friction against the interior. *Out of the barrel*, because the resistance of the atmosphere is seldom directly opposed to the motion of the centre of gravity. Experiment proves that the rotation always exists; for if a mark is placed on the ball, and that mark placed outward in the barrel, upon firing into a soft substance it will be found that the marked spot occupies every conceivable position in the target.

The existence of an independent and uncertain rotation being proved, it is necessary that this motion should be annulled. This is effected by tracing upon the interior of the barrel spiral grooves, into which the ball is forced by ramming, or otherwise; the ball, upon the charge being fired, follows the direction of the grooves and issues from the barrel in the manner of a short screw of several threads from an elongated nut, the axis of the ball coincident with that of the barrel; this causes a rotation which preserves the axis constantly parallel to its initial direction during the time of flight, presents any inequalities of weight or of figure alternately to the right and the left, above and below the line of flight, thus equalizing the causes of deviation. This last, however, is not strictly true; for the causes of deviation are more energetic nearer the muzzle, consequently, if the progressive velocity is very great, while that of rotation is but feeble, the resistances are not equal at the points where the inequalities are on opposite sides of the axis, and a deviation will occur. Rifling the bore, therefore, diminishes, but does not entirely overcome, the deviating forces; in fact, it introduces certain deviations, small in amount, but peculiar to itself, which will be hereafter noticed.

It is a known and generally admitted fact, that by diminishing the windage of the musket, (*windage* is the difference between the diameters of the barrel and the ball,) we increase the accuracy; taking into consideration the preceding facts, some persons have expressed doubts as to the necessity of rifling the bore, and have asserted that by causing the windage to entirely disappear, that is, *forcing* the ball, as great a degree of accuracy can be attained as with the rifle; experiments made with smooth bores, and the same barrels afterwards rifled, proved conclusively that the rifle is greatly superior in accuracy.

The theory of the effect of rifling would also appear to render unnecessary any experiments upon straight grooves, since they cannot cause the ball to rotate; nevertheless, comparisons were made, and the results found to differ but little from those obtained with the smooth bore, and of course greatly inferior to the rifle.

Having thus determined that for accuracy at considerable distances, it

was necessary to adopt the principle of the rifle, a series of experiments was made to determine—

*The Mode of Loading.*—Loading at the breech. This mode is the oldest known, and has several advantages; the principal are, an increased range and accuracy, and less recoil on account of the reduction of the charge; to these advantages we may add, when the mechanism for closing the breech is well arranged, facility and rapidity of firing, the importance of which is greatly exaggerated by inventors, but which is not without real value, are greatly increased. Unfortunately, it appears difficult to combine all these advantages with strength and simplicity, and above all, capability of furnishing prolonged service under the ordinary circumstances of a war.

The Prussian needle gun is one of the latest arrangements for loading at the breech; (a complete description of this gun is to be found in *Appleton's Mechanics' Magazine* for March); it has sustained the effect of protracted firing without injury; the arrangement is objectionable in several respects, but a fatal one is, that if the needle fails to ignite the priming, the cartridge must be withdrawn. Jennings' repeating rifle also loads at the breech, and is probably one of the best of this order of rifles.

The cartridges of these two rifles are arranged upon precisely opposite principles. In the needle gun, the powder adjacent to the ball is first ignited; consequently, the ball when once in motion, is driven forward by a force less than that due to the greatest tension of the gas; for this force is evidently greater at the breech, where the combustion of the grains and evolution of gas is still going on, than at the place of the ball some distance off. In the Jennings rifle, the charge is ignited at the bottom; the loaded hollow ball carries the powder within it, and as the grains are successively consumed, the greatest tension and elastic force is exerted upon the ball at the instant and at the point where the last grain is consumed; a very small charge, therefore, produces a maximum effect.

Loading at the muzzle. This method takes more time than the preceding, fatigues the loader more, and increases the wear of the barrel to such an extent, particularly near the muzzle, that it is doubtful whether the greater simplicity of construction compensates for its inferior rapidity and difficulty of manipulation, and after some service, its diminished accuracy. Numerous methods of loading have been proposed to diminish these disadvantages.

1st, Loading with the aid of the mallet. This method is very objectionable, except for short distances as in pistol galleries, where this mode is usually adopted; any mode of forcing the ball which deforms it, as hard ramming or driving with the mallet, is injurious to the range, but favorable to accuracy, as it is susceptible of demonstration that the shortest axis is the axis of the greatest moment of inertia around which the motion of rotation is the most stable.

2d, With a greased patch. This method has almost entirely superseded all others; at the same time that the patch destroys the windage, it cleans the barrel for the next round. It is not, however, without serious objections; if the ball fits tightly, it is difficult to enter and force home with the ramrod; if the ball enters easily, it must be forcibly rammed, when home, to spread it into the grooves; an operation at once fatiguing to the loader,

and injurious to the shape of the ball. To assist in loading, there is furnished with the best American target rifles a *straight starter*, and a false or loading muzzle, which enters the conical ball fairly.

3d, The belted ball. The English military rifle has but two grooves; the ball, cast with a belt upon it, is enveloped in a greased patch, and the loading is performed with but little greater difficulty than with the musket; this is a very rude weapon, and except at very short ranges, has little accuracy or force; it is not astonishing that a people using a weapon which, compared with a Wesson's American rifle, stands in about the same relation to it that the bow and arrows do to a musket, should consider the authenticated performances of the latter as fabulous.

4th, The elliptical ball fired from a helical elliptically bored barrel. This idea, which has lately been reproduced in England under the name of Lancaster's elliptical *rifle*, dates from 1795; the practice with, has demonstrated that it is, independent of the difficulty of construction, inferior to all the modern rifles.

5th, The *carabine à tige*, or French pillar breeched rifle. This has also been imitated in Lancaster's pillar breeched rifle, and Wilkinson's stadia rifle. In this rifle, a steel pin, or pillar, about half the diameter of the bore, and three inches in length, is screwed into the centre of the breech pin; the powder fills the space around this pillar, and the ball is arrested by the end which is a plane; moderate ramming with the rod, spreads the ball into the grooves without crushing the grains of powder, or seriously deforming the ball; it was for this rifle that the grooved cylindro-conoidal ball was invented, which has reached a range and degree of accuracy hitherto unequalled.

6th, The Miniè mode of loading. The accumulated dirt in long continued firing, and the difficulty of cleaning the breech, caused serious objections to be raised to the preceding mode of loading. Mr. Miniè, therefore, proposed to hollow the base of the conical ball, and enter in it the point of a conical iron cup, or plug, which should be driven into the cavity by the force of the charge, expand the ball into the grooves, and thus force the ball without effort on the part of the loader. The loading is as rapid and simple as with the musket, and no alteration is required in the rifle; the ball alone is of different construction. The numerous and severe tests to which it has been submitted in Europe, would appear to be perfectly satisfactory, and it has been adopted by several nations. Still, it is open to objection; one of which is, that if the cartridge is damaged by exposure, the expansion may be either irregular or inefficient, and all accuracy lost. A small quantity of fulminating powder inserted in the cavity, would also produce the required effect, but the union of fulminating powder with the cartridge is highly objectionable, either in magazines, or during transportation from place to place. The great advantages of this discovery may lead to the adoption of the rifle as the sole weapon of the infantry soldier.

*The Charge of Powder.*—The charge of powder is only to be obtained by experiment; it should be sufficient, but not excessive. We must, therefore, consider, 1st, the quantity of powder which can be burnt while the ball is passing along the barrel: 2d, the required range, force, and accuracy: 3d, the recoil. Experiment proves that heavy charges pro-

duce great irregularities, and that the accuracy increases with the diminution of the charges; hence, the smallest charge capable of producing the required effect, is to be preferred. The recoil being directly proportional to the charge, it is evidently favorable to accuracy to employ small charges, by which we also diminish the inconveniences of fouling.

*The Diameter and Shape of the Ball.*—When the rifle loads at the breech, the ball should be of slightly greater diameter than the barrel, that the ball may be *forced* (caused to fill the grooves) by the action of the charge; if loaded at the muzzle, the ball must be somewhat smaller, or it will be deformed by the blow of the mallet, or other means adopted to enter it; it must also be of such diameter that the fouling of the bore will not prevent it from being rammed home; at the same time the windage must be sufficiently small to permit the spreading of the ball to fill the grooves without excessive ramming, which fatigues the loader and deforms the ball.

Hitherto, the spherical ball has generally been used, but it has been proposed to substitute a conical, cylindro-conical, or cylindro-conoidal ball; the first attempts were not successful; the ball was found to be deficient in stability, and abandoned.

When a spherical ball is fired with great velocity, the air in front is partly displaced, partly condensed, and driven before it, the particles forming a sort of conoid, having a base equal to the diameter of the ball, and a height dependent upon the velocity. If, then, the anterior surface of the ball is made the shape of this conoid, the escape of the condensed air will be facilitated, and the resistance due to its elasticity reduced to a simple friction. But since the axis of the conoid passing through its apex is that of the least moment of inertia, the conoidal ball is more affected by causes of deviation than the spherical ball; to overcome these defects, it becomes necessary to increase the rapidity of rotation; and since the elongated ball offers a great surface to the action of the grooves, there is no difficulty in combining a rapid rotation with considerable velocity. This developed a new deviation peculiar to the rifle, due to the parallelism of the axis of rotation. This deviation, which was named by the discoverer *derivation*, was observed to be always to the right or the left of the object, according as the turns of the spiral were from left to right, or right to left; and, increasing with the rapidity of rotation and the distance, can only be due to the rotation itself.

If we fire an elongated ball at a distant object, the axis of the rifle must be aimed sufficiently above it to compensate for the effect of gravity; the axis of the ball on issuing from the muzzle, takes the direction of the line of flight, the resistance of the air is concentrated upon the apex, consequently, the friction caused by the rotation is distributed equally around the ball, and there will be no deviation; but as the ball approaches the target, the axis, preserving its parallelism, makes an angle with the path of the ball, the anterior surface experiences greater pressure from the condensed air in front, while the posterior surface is in a vacuum, and there will be an unequal friction, which will impel the ball towards the right or left, depending on the direction of rotation. At 900 yards, with a cylindro-conoidal ball, the derivation amounted to four yards.

A careful study of these effects led to a discovery of the causes pro-

ducing and the means of correcting them, and subsequent experiment arranged the details of the *grooved* cylindro-conoidal ball, which in the *carabine à tige* and Minié rifle, has proved so efficacious.

The theory of this ball is easily explained. The centre of gravity of the ball being in the line of flight, and the axis making an angle with that line, any resistances in the rear of the centre of gravity must have a tendency to cause the ball to turn on that point, and make the axis of the ball coincide with the line of flight. This resistance was produced in the model ball by forming on the cylindrical part several circular grooves of a triangular section, the rear face perpendicular to the axis of the ball. Experiment fully confirms what theory designated as the remedy. The axis of the ball is constantly directed in the line of flight, the *derivation* disappears, the ball experiences the least possible resistance, and retains an almost incredible degree of force and accuracy at distances beyond the limits of distinct vision.

*The Length of Barrel.*—The charge should be such that its inflammation may be completed before the ball has left the gun; but as the charge is fixed in advance at the least quantity to produce the required effect, it follows that the barrel should be shortened to that point. An excessive length can but increase the friction and diminish the range, while experiment shows that it injuriously affects the accuracy.

*The Inclination or Twist of the Grooves.*—To determine this, we must examine the relations existing between the charge of powder and the inclination. It is evident that with equal charges, the rapidity of rotation increases with the inclination; it would therefore appear to follow that the accuracy should correspondingly increase; but as the rotation is produced by the friction of the ball in the grooves, if the charge is great and the twist quick, the small portions of lead entering these grooves are not capable of offering sufficient resistance to rupture, the ball will not follow the direction of the grooves, it must be cut or stript, and issue from the barrel greatly deformed, and totally devoid of accuracy. On the other hand, if the inclination is too small, the rotation will not be sufficiently rapid to overcome the several causes of deviation; it follows that we must increase the length of the spiral as we increase the charge.

The experiments to determine this point were made upon two natures of twist; the uniform, and the parabolic or increasing twist. In conformity with the laws of the motion of bodies, we should progressively increase the inclination of the grooves to the axis; for the ball being subjected at the same time to two motions, necessarily has a tendency to escape from the grooves; and the greater the inclination, the more difficult it will be to overcome this tendency; therefore, there should be some ratio established between the velocities of the motions of rotation and of progression. The experiments proved that for a quick twist of a turn in three to six feet, the increasing twist was preferable; but that for a spherical ball of musket calibre, a twist of about one-seventh, or a turn in twenty feet, was sufficient, and that for this length of twist the increasing twist had no advantages. The conical ball rotating on the axis of the least moment of inertia, requires a more rapid rotation to insure the stability of this axis; furthermore, the effect of the deviating force increasing with the diminution of the bore, it follows that the smaller the diameter of the ball, and the

greater its length in proportion to its diameter, the more rapid should be the twist. Rifles have been made in this country with a twist ending with a turn in eighteen inches; if this excessive twist was necessary to insure the stability of the ball, there were defects in the rifle, and the shape of the ball, which should have been remedied. Experiment shows, that with the same charge and more than a necessary degree of twist, there is a loss of range, accuracy, and killing force, at long distances; this is conformable to theory, for the friction and loss of force evidently increases with the twist.

Experiments were also made upon the *decreasing twist.* This idea has lately been reproduced and advocated by Greener in his treatise on the gun; these experiments proved that this was decidedly the least advantageous of all the methods proposed. The projectors of this arrangement argued, with some plausibility, that the velocity of rotation, (that is, the number of turns in a second of time,) was not due to the inclination of the grooves alone, but also to the velocity of the ball; and as this velocity was constantly increasing until the ball reached the muzzle, the inclination should decrease, that the ratio of the velocities should remain constant.

*The Number of Grooves.*—It has been shown, that diminishing the twist, to a certain limit, was attended with increased range and accuracy. Similar results attended a reduction of the number of grooves. At least two grooves are necessary; a single one would cause deviations from the instant the ball left the barrel. The number should be such that but moderate ramming is required to spread the ball into the grooves; for if the number is small, the depth must be correspondingly increased, to give sufficient hold to prevent the ball from stripping. If the number of grooves is an even number, the ball must be enlarged by ramming in the direction of a diameter by twice the depth of the groove; if the number is odd, the solid opposed to the crease assists in spreading the ball into the grooves. For these reasons an odd number is to be preferred; from five to seven is the preferable number. The *carabine à tige* has four, the Minié rifle five; some rifles have upwards of a hundred.

*Depth of the Grooves.*—The depth should be such that a moderate force will cause the lead to entirely fill the groove; otherwise a portion of the inflamed powder will escape through the grooves, injuriously affect the range and accuracy, and injure the barrel. If the grooves are very deep, the projections raised upon the ball will diminish its velocity and accuracy; consequently, too great a depth cannot be otherwise than injurious. Experiment must determine for the particular calibre and charge the least depth necessary; arms loading at the breech require a greater depth than those loading at the muzzle. The grooves should be of equal depth, *at the same distance* from the muzzle, or the unequal projections raised on the surface of the ball may cause great irregularities. Recent experiments have, however, shewn that it is highly advantageous to diminish the depth of the grooves *as they approach* the muzzle, and even that no injury is produced if a few inches near the muzzle are left smooth; this arrangement keeps the ball constantly fixed solidly in the groove, while the friction against the *lands* (or solids between the grooves) is scarcely sensible; the ridges raised on the ball by ramming almost entirely

disappear. In the American target rifle, particularly those of Wesson's make, the same object is sought to be attained (the solidity of the ball) by freeing the bore from the muzzle towards the breech; this method is attended with increased friction, on account of the greater surface of lands than of grooves, and has also the disadvantage of increasing the ridges raised by ramming.

*The Shape of the Grooves.*—A great many trials were made of grooves of different cross section. Of all the forms tried, the rectangular, with the interior angles rounded off, proved superior; for since neither the lead nor the patch can be forced into the angles of other grooves, they permit an escape of gas injurious to range and accuracy. It was also found preferable to have greater width of lands than of grooves; and that for the number adopted, three-eighths of the total circumference was sufficient.

*The Thickness of the Barrel, and Material of which it is composed.*—It is a firmly rooted popular opinion, that the barrels of rifles must be very thick, and the weapon heavy and unwieldy, to fire with accuracy; but repeated experiments have proved that a diminution of thickness and of weight had no injurious effect upon the accuracy, except so far as it increased the recoil, with charges much greater than any proposed for service. The musket barrel rifled gave results equal to the rifle of equal diameter of ball, weighing two pounds heavier. The homogeneity of the material composing the barrel is of much greater importance; a want of this quality causes an irregular vibration and a curvature of the barrel from unequal expansion. To insure a greater degree of it, the barrels of rifles, formerly made of iron, are now universally manufactured from cast steel. In addition to greater strength and homogeneousness, its hardness preserves the muzzle from wear, a matter of very great importance; for any aperture which may permit the gas to escape before the ball leaves the muzzle, must cause an initial deviation variable in amount, therefore not to be counteracted. For this reason, the best American target rifles are furnished with a false or loading muzzle, and the conical ball is entered with a straight starter, which preserves its axis perpendicular to the plane of the muzzle.

*Vibration of the Barrel.*—It is generally supposed, that by firing several successive shots from a rifle always charged and pointed alike, at a target placed at a short distance, the balls could not deviate in any direction, and therefore should pass through the same hole; but this is not the case. Upon firing several shots, from different barrels, through a piece of pasteboard placed six feet from the muzzle, it was observed that after a certain number of rounds, a circular opening was formed nearly double the diameter of the ball, the centre of which coincided with the axis of the bore. It was also proved that like results followed the use of the rifle and the musket, and that the deviations were in all directions. These results can only be attributed to the vibrations of the barrel.

These vibrations are of two sorts; the one perpendicular to the axis occasions a momentary swelling; the other, longitudinal, displaces the axis itself by an oscillatory movement; this longitudinal vibration, which is the most important, increases with the charge and the checks to a free recoil; the barrel recoiling freely, the vibration is scarcely sensible. It is also proved that recoil commences before the ball leaves the barrel.

The deviations being similar near the muzzle for all the barrels, rifled or smooth bore, good or bad, it is evident that the deviations at great distances can only be attributed to the resistance of the air; another proof that the principle of the rifle is necessary to diminish the effect of this resistance, but cannot cause the deviations to entirely disappear; also, that the figure and weight of the ball are of much greater consequence than is generally supposed.

A careful study of the facts brought together in the preceding pages, has led the writer to the following conclusions:

That the American rifle made by the best makers is a nearly perfect weapon, principally faulty in the smallness of the bore and too great length and weight of the barrel. But while the weapon itself so nearly fulfils the theoretical and mechanical conditions necessary for a successful practice, the manipulation and accessaries are decidedly faulty. The loading is difficult, tedious, and requires much practice and expertness; the balls are generally very acute conoids, with plane or hemispherical bases, the most susceptible of all forms to deviations; the rifle is in practice greatly overcharged, endeavoring to obtain by great velocity of ball a force and accuracy better obtained with a better form and greater weight. The heavy charge requires great strength of barrel, and consequently thickness and weight, to withstand its force, gives considerable recoil, and makes it necessary to clean the gun after a few rounds.

Practice with a rifle in the possession of the writer, made by Wesson, (admitted to be the best of makers,) of a calibre of forty-five spherical balls to the pound, proves these conclusions to be correct. The barrel, freed from near the muzzle towards the breech, was thirty-four inches long, rifled with an increasing twist, ending with a turn in six feet. The ball is purely conoidal; consequently, unless it is entered with the utmost nicety, the axis does not coincide with the axis of the bore; the charge was so great, that unless the ball was hardened with tin, it was frequently upset by the force of explosion.

The charge was subsequently reduced one-half; the ball increased in length to two diameters, three-eighths cylindrical, the other portion conoidal, the tangents to the curve at the apex forming an angle of about 70°; three grooves were formed upon the cylindrical part of the ball; the barrel was shortened to thirty inches. These alterations have been attended with the expected success. At the distance of forty to sixty rods, there is no perceptible advantage; but on increasing the distance, the superiority becomes more marked, till at 150 rods the accuracy is nearly doubled.

To obtain satisfactory results, so many precautions are necessary, so much practice required, and so long a time required to load the rifle, that it is not probable that such a weapon will ever be used for any other purpose than target practice, and some more convenient weapon must come into use.

The principle of loading at the breech, although liable to objections, must be admitted to be very advantageous, and can scarcely fail to be adopted for sporting purposes, arming of volunteer troops, and even a portion of the regular forces. Although the rifle so constructed is some-

what more difficult to manufacture, it is, by dispensing with the ramrod, more conveniently handled: if the mode of closing the breech is well arranged, the duration of the arm is at least equal to that of a rifle loading at the muzzle. The manual is more simple, easily learned, and the rifle may be loaded with facility even when lying down; the charge being small, the injuries due to its corrosive action are sensibly diminished: the recoil is scarcely perceptible, and the gun may be loaded an unlimited number of times without cleaning: for the same weight of gun, the bore may be larger, which has been shown to be advantageous.

A rifle on this principle, of a half inch bore, (32 to the pound,) properly constructed, firing a conoidal ball, with a charge of thirty grains of rifle powder, will be effective at half a mile, a distance beyond the limits of distinct vision, or our means of estimating distances with precision.

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For the Journal of the Franklin Institute.

## *Railways and other Roads.* By J. H. Fisher, Esq.

I propose to examine the question, whether the railway is the form of road which, so far as we now can see and judge, is the most economical and agreeable for populous districts.

Inventions are often the offspring of accidents, and always more or less modified by accidents. Roads, more than other inventions, have been subject to such modification, and turned from their normal growth by it; and until freed from it, they cannot attain to a condition that will satisfy the requirements of the various kinds of travel that must pass over them.

The motive power is the first accident that has modified roads. Without going back to semi-barbarous ages, in which none but rude vehicles existed, and roads were pathways of common earth, I will notice the modifications now adopted to accommodate them to animal power. Stone pavements are grooved, sometimes roughened over their entire surface, to give a firm foothold to horses; they are made of stones so small that they will form an uneven surface. All this roughness and unevenness of surface is injurious to the road as a street track, but necessary to enable the animals to obtain such a foothold as will resist the tendency to slip.

Railways, from their beginning until locomotives were introduced, were made for burdens so heavy that the common roads of the time could not bear them; and in order to draw such loads, it was necessary that the horse track should afford a secure foothold. The earliest were mere timber tracks for the wheels, with the common earth, or at best a gravel track, between them. As it was found that the timber would not without injury bear the pressure of the wheels, strips of iron were put upon them; and finally, iron rails upon cross sleepers of timber came into use, as the locomotive gradually developed itself.

It appears to me that the narrow wheel track, which could not have been kept except by slow moving vehicles, and the flanch rail or tram, were too obviously inconvenient to have been adopted, were it not for the necessity of a surface into which the horse could indent his toes, and

obtain a firm hold; and thus far at least the railroad seems to have derived its form from accident.

Let us now consider what might have been the form of the early colliery roads, had timber been cheap enough to make the whole surface of it, and had there been a varied and abundant traffic, requiring different rates of speed, turn-outs, stoppages, and all the impediments of roads in populous districts, and had the locomotive attained to the efficiency and cheapness of structure that characterize the light locomotives of the present day. The service required was to draw heavy loads at a rate so slow that a very simple steering apparatus would have sufficed. It was necessary, or at least desirable, that the colliery vehicles should pass each other; and other vehicles could not use the road unless allowed to pass freely by the burden vehicles. There can hardly be a doubt that the whole surface would have been timber; and a plank road, of the thickness and strength required for the service, would have been the result.

Or, if the locomotive had attained to this condition at the time when the lengthwise timber track was guarded from the crushing weight by a strip of iron, the question of a fulcrum for the motive power would have soon been settled, and an iron surface would have been adopted, unless the horse traffic were of such amount as to require a less slippery surface. As the case actually stood, there was an accident, which would have been less influential in the case we have supposed, but which had much to do with preserving the railway form. I allude to the strange notion that the adhesion of the wheels was insufficient to enable the locomotive to draw a load, or work upon a smooth surface more advantageously than horses could work. To overcome this imaginary difficulty, the toothed rail of Blenkinsop, and various imitations of horses' legs, were devised; all of them requiring that the rail should be preserved. This delusion might have been dispelled sooner, had the grades not been so steep that slipping would in some cases unavoidably occur if the loads drawn after the locomotive were of the usual weight that it could draw upon the lesser inclines.

These accidents, concurring perhaps with others, seem to have given rise to a system that could not have grown to its present magnitude had not the minds of the engineers, or mere workmen, been incapable of thoroughly investigating the subject before them. Step by step, the rail system advanced, from the timber track to the tram, from the tram to the rail for the flanch wheel, from the light and flimsy rail to the heavy and firm rail now in use. In the mean time the traffic increased, and demanded prompt and unremitting action, rather than deliberation. Inventors were required to determine how to time the trains, and avoid collisions and delays. This they accomplished by diminishing their number, and increasing to an enormous weight and size the cars and engines, so that instead of the three or four tons which a convenient passenger vehicle might have weighed, the passenger train now weighs a hundred tons or more.

While railways have been growing in this way, some efforts have been made to improve common roads; but they have been hindered, and until within a few years defeated, by the difficulties which lie in the way of level grading, and by the requirement of a surface upon which horses

can draw heavy loads without stopping. Cast iron pavements were tried in London twenty years ago, and abandoned because they were slippery. Stone tracks, composed of long dressed stones, with rough horse tracks between them, have been used where there is but moderate traffic. But in the main thoroughfares the improved wheel surface has been deemed an insufficient compensation for the danger of injuring horses, and stopping crowds of vehicles by their fall. A new trial of iron paving is now being made in Glasgow, thus far with such satisfactory results as make it probable that it will be generally adopted. The grooving is improved, so that the old difficulty of slipping is avoided; and the structure is cheaper, and promises to be more durable, than stone pavement. The cost is within two dollars per square yard; and if allowance be made for the exemption from the necessity of such repairs as are required by the wooden portion of railways, it appears that an iron pavement of sufficient width for turning out will not cost more than a double railway.

If we now suppose that horses are on the whole as expensive as steam power, in the present state of invention and workmanship, we may fairly assume that a road can be made of iron, with a surface and grade equal to the railway, which will accommodate every variety of traffic, and admit the use of vehicles that can diverge from it to reach the places where their burdens are to be set down and taken up. It is a fact well established, that no kind of road in ordinary condition is absolutely *impracticable* to steam carriages, however *unprofitable* it might be to run them upon bad roads alone.

Upon such a road there would be no necessity for mammoth trains, starting at long intervals, and stopping only at distant stations, requiring passengers to pay two coach fares in addition to the railway fare, in order to complete their journey. The loads would be light, and go without change of vehicle from their departure to their destination; passenger vehicles that must move rapidly, would be light, so that if they should run off the road, no damage could occur; and accommodation stages and private carriages could again come into use, and move as rapidly as the locomotive; and as they would avoid the delay of transhipment, they would perform their service with more despatch than the railway, at least upon short lines of travel.

Such a road could be sodded to the edge, and perfectly free from dust; and as it would be supported at all points upon a bed of concrete, and free from roughness, the wheels would run over it with very little noise or jolting. A smooth and quiet motion, with the privacy of one's own vehicle, and the comfort of having it well ventilated by the blowing-fan, and warmed by the waste steam, would render travel a luxury to be enjoyed, rather than a necessity to be endured, as it often is under the present system, especially in dry and dirty weather. And were street pavements made of iron, and horses not used, they would be free from dust and mud; and the expense of cleaning would be slight—the rain alone would keep them always cleaner than stone pavements can be kept by the usual process.

The expense of such a system should be estimated by a fair comparison of its utility with its cost to *all* who aid in paying for it. The cost of paving, street cleaning, road making, and much of the cost of clothing,

are fairly chargeable under the general head of cost of transit; but it has been too much the custom to look solely to the total expense of maintaining horses and their vehicles, and comparing it with the cost of other motive power, without reference to the comparative wear of the public roads, to the damage to private property and comfort by dust and mud, to the time lost in traveling, and to the wear of vehicles, and other expenses incidental to the form of road which we have assumed as the temporary and imperfect form. If the damage to clothing, comfort, and health, were much less, there would be a gain; not, however, to the coach proprietor, and he would not pay for it; if the time of travel were less, there would be a gain, but not to the public carrier; if street cleaning were lessened, there would be a gain, for which the coach proprietor might be willing to pay a part. But all these interests, and many others, will remain without the union that would produce reform, until the public constructs the roads, and distributes the taxes according to the benefits. If a road be made agreeable to the fastidious tastes of the wealthy, always perfectly clean, free from uncouth sights, and its sides beautifully ornamented with trees and shrubbery, it would be just that the pleasure carriages of that class should pay a tax somewhat proportioned to their value, and that the plain vehicle of the man in moderate circumstances should pay less. Part of the tax would be for embellishment—that part should be assessed chiefly upon those who would not willingly dispense with it; another part would be for wear of road, and that part should be assessed as a mileage tax, or, what might amount nearly to the same thing, each keeper of a carriage should pay a certain amount upon the renewal or repairs of his wheels.

But during the transition state, while horse power and elementary power are struggling for ascendency, roads will be of a mixed character. The general form of the train or track road will be more or less adopted. If iron be the material, the horse tracks will be grooved, and the wheel tracks smooth. But it will be found that habit and training will accustom horses to the smooth surface, so that, with light loads, they will not slip. The grooving will soon be dispensed with upon the level portions. In the mean time, every year will cheapen and improve machinery, until it will be no longer expedient to provide for the use of horses; and the roads will then be made of their normal form.

The present cost of steam power is a question of interest, which is more or less discussed, in England and this country. A select committee of the House of Commons, in 1831, after hearing the evidence of the proprietors of steam carriages, and numerous men of science, reported that steam carriages would become "a speedier and cheaper mode of conveyance than carriages drawn by horses." This prediction is by some thought to have failed; but what is the locomotive? it is a steam carriage, of huge size and proportion, running upon narrow tracks. This steam carriage has reduced the cost of traveling to a third, and increased the speed eightfold. Lighten it, give it a steering apparatus, run it upon a broad, flat surface, with railway grades, and you will not have impaired its efficacy; it is even now maintained in England, that two light locomotives to a train, are more efficient and economical than one heavy one: this, however, may be due to improvement in the plan or execution, or it may be a surreptitious puff. But if the prediction be not verified as to macadam

road carriages, it is because the iron road has proved the better and cheaper road, and with its steam carriage, has superseded almost every line of stage coaches in England.

I submit, then, that the steam carriage has not been beaten; it is the iron road that has beaten the stone road. What this or that inventor may have failed to do, is of little moment; but as the failure of Garry, Hancock, and others, is often quoted as a reason for doubting the power of steam to work upon common roads with economy, it is but just to say, that they were subjected to prohibitory tolls, which the House of Lords refused to regulate, after the Commons had passed a bill to regulate them; and that the same body refused to extend the patents, which had nearly expired before the inventions became efficient, and really got a little into use. It was not horse power that drove them from the macadam roads, but the power of the land interest, represented in the House of Lords, and in the turnpike trusts. The same interest opposed railways, from the same motive, the fear that the price of horse feed, and the rent of land, would not continue to rise.

Railways may for a long time occupy the long lines of travel, where there is little occasion for frequent stoppages; but in the vicinity of great cities, the iron road will be the more convenient, agreeable, and economical. It will admit the stout burden wagon, at a speed of eight or ten miles, which will not render it liable to run off the road; and it will allow free course to the light passenger carriage, at railway speed; and should it leave the iron track, as the locomotive sometimes does, its wheels will not cut into the ground, and it will easily regain the road without injury.

There is a vague notion that steam power is enormously heavy. The weight of the broad gauge locomotives, is 156 lbs. per horse power. The tender with its load may be one-fourth as much, or the total weight of the power and the vehicle to carry it, is within 200 lbs. per horse power, even in those engines which are made for long endurance, and with little regard to lightness. It may be reasonably estimated that a horse power would not exceed the weight of a passenger; and that a carriage which is strong enough to carry twelve passengers when drawn by two horses, would carry at least ten, if it had steam power attached to it. This basis is estimated upon what has been done; a careful estimate based upon the strength of materials, and the power obtainable from fuel and water, shows, that the motive power, apart from the vehicle that bears it, need not weigh more than fifty pounds per horse power.

The question of manageability has been settled by the experiments of the English; they can be managed with more ease and precision than horses. There is no smoke, noise, visible steam, or other nuisance attending them. And, although they employed two, and sometimes three men upon each carriage, there is no doubt that one man is capable of doing all that is required upon the roads. The fuel and water are supplied at the stations, and so disposed that they are fed into the furnace and boiler without any attention from the conductor; and a gentleman will find it by no means unpleasant to manage his own carriage, which he can do from within, without the least exposure to the weather.

I have inquired of machinists as to what it would cost to construct the machinery for a carriage for four or six persons, and I find it would be

about seven hundred dollars. The interest on this sum, and an allowance for wear of double the amount in locomotives, with the expense of fuel, oil, etc., and all other expenses, would not amount to so much as it costs to keep one horse and his vehicle. It is therefore probable that private carriages will come into extensive use as roads improve. And the sooner the main roads are improved, the sooner will this convenience be within the reach of all industrious and economical persons.

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*Observations on Artificial Hydraulic or Portland Cement; with an Account of the Testing of the Brick Beam erected at the Great Exhibition.* By Mr. G. F. White, Assoc. C. E.*

After detailing the experiments made by the late Sir Isambard Brunel, the paper noticed the peculiarities in the practice of the English and foreign engineers in the use of cements and limes. It was stated, that in England, the natural cements were plentiful, and the mode of construction being generally in brickwork, quick setting cements were preferred; whereas, abroad, the natural cement stones were, comparatively speaking, rare, and the use of bricks rather the exception than the rule. In some cases it was found, that even the best natural hydraulic limes did not set with sufficient rapidity in salt water, to do away with the necessity for using pozzalanos; and some of the attempts made at various periods to substitute artificial pozzalanos for the very expensive natural products of that nature, were then described. The unfavorable results of these attempts, and the manner in which M. Vicat explained them, were detailed. A sketch was then given of the course of investigation followed in England by Mr. Frost, and General Sir Charles Pasley, from which it appeared that, until the introduction of the Portland cements, no artificial compound had been discovered, which possessed the same, or greater powers of resistance than those of the natural cements. The advantages of the Portland cement were stated to be that it had nearly all the qualities of rapid setting presented by the natural materials of the same class; and, in addition, that as it was capable of supporting variable proportions of sand, it could be used as a mortar, the rate of setting of which might be modified at will, and the powers of resistance of which were stated to be much greater than those of either the cements or the limes thus replaced.

A general description of the manner in which the Portland cement was now manufactured, and of the methods of testing the article, were then given; and it appeared, that, after seven days, the cohesive strength of the neat cement was equal to about 100 lbs. on the square inch; and that after six months, this became equal to not less than 414 lbs. per square inch. M. Vicat had stated, in 1851, in a communication to the *Annales des Ponts et Chaussees*, that by the use of Portland cement alone, or what he termed "overburnt lime," it would be possible to form immense artificial blocks, capable of resisting the action of the waves and of the shingle upon the sea shore; an action which it was well known rapidly destroyed the natural cements, and the pozzalanic mixtures, whether of natural or artificial pozzalanos.

* From the London Journal of Arts and Sciences, July, 1852.

The several applications of the Portland cement as a concrete, as a mortar, and as a stucco, were then alluded to, and reference was made to the early failures in forming large artificial blocks; and an account was given of the mode now adopted in constructing them at Dover and Alderney harbors of refuge, and likewise of those employed to protect the extremities of the breakwater of Cherbourg. At Dover, the hearting of the piers, below high-water mark, was executed in blocks of concrete, composed of cement and shingle in the proportions of 1 to 10, and occupying about three-fourths of the volume of the separate materials measured in the dry state. Each block contained from 30 cubic feet to 120 cubic feet, and weighed from 2 tons to 7 tons. At Alderney, a species of concrete, composed of cement, sand, and shingle, was placed in a mould, with rubble stone, bedded irregularly in the mass; the proportions being about one part of cement to ten parts of foreign materials. At Cherbourg, the system adopted was to build immense blocks of rubble masonry of not less than 712 cubic feet, and weighing about 52 tons. These blocks were floated out from the places where they were constructed, and sunk as "pierre perdue;" but this had not on all occasions been able to resist the transporting power of the waves. The manner of using the cement was in the form of mortar, composed of one part of cement to three parts of sand.

It had been stated by M. Vicat, that the powers of resistance to compression absolutely required, in substances exposed to the action of the sea, must be at least equal to 40 lbs. per square inch, and of that to tension at least equal to 9 lbs. on the square inch. Now, the resistance of the artificial stone blocks, after an interval of nine months, was not less than 1700 lbs. per square inch, when the effort was one of compression, or than 200 lbs. per square inch, when it became an effort of tension, or little inferior to that of Portland stone itself.

Attention was called to the fact, that the Portland cement adhered more energetically to the Portland stone than to any other material. This degree of adhesion did not seem to depend so much upon the absorbent powers of the substances connected together by the cement, as upon some coincidence in the manner of their crystalization.

The applications of Portland cement to the purposes of stucco, for external works, were noticed. Its advantages were stated to consist in its agreeable color, without the intervention of paint or lime-white, its power of resisting frost, and its freedom from vegetation: all which were attributed to the close contact of its constituent parts, and to the surface being perfectly non-absorbent. For the same reason, it was asserted that the Portland cement was eminently adapted for the construction of cisterns and baths, and for the various descriptions of statues and fountains, &c., now made of artificial stone.

The paper concluded by a description of the experiments on the brick beam at the Great Exhibition of 1851: from which it was deduced that the strength of Portland cement, as compared with Roman cement, was in the ratio of $2\frac{1}{8}$th to 1. Attention was called to the several tables and diagrams, which were exhibited, illustrative of the various power of resistance of the cement under efforts of compression, extension, and tearing asunder.—*Proc. Inst. Mech. Engineers.*

# AMERICAN PATENTS.

*List of American Patents which issued from July 6th, to August 3d, 1852, (inclusive,) with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improved Centre Square for Finding the Centre of a Circle;* Nathan Ames, Saugus, Assignor to Walter Bryent, Boston, Massachusetts, July 6.

*Claim.*—"What I claim as my invention is, 1st, The application to an instrument, substantially in the manner herein set forth, of a geometrical fact, viz: that any circle touching the sides of a right angle may be divided into two equal parts, by the line which divides the right angle into two equal parts.

"Secondly, the union of the above with the common "trying square," by means of the bar as described."

2. For an *Improvement in the Construction of Bridges;* Abel Bradway and Elijah Valentine, Monson, Massachusetts, July 6.

*Claim.*—"What we claim as our invention is, the combination of the string pieces with the posts, the cross joints, the saddles, the diagonal braces, and the ties of a bridge frame, in such manner that the said string pieces are enabled to move longitudinally under the influence of variations of temperature, or other cause, without injury to themselves, or to the parts with which they are combined, substantially as herein set forth."

3. For an *Improvement in Car Seats;* John Briggs, Boston, Massachusetts, July 5.

*Claim.*—"What I claim as my invention is, a car seat constructed with a double back, which can be folded up or unfolded, by means of the hinged arms, operating as above set forth; the two pieces which constitute the back being held together when open or raised up by the spring lips, substantially as above described."

4. For an *Improvement in Turning Engines;* James S. Brown, Pawtucket, Massachusetts, July 6.

*Claim.*—"What I claim is, the clasp, in combination with the slide and saddle, for the purpose of arresting the combined operation of the slide and the pattern when required.

"And I also claim the cylindrical nut, in combination with the standard and tool holder of the slide rest as described, by which the edge of the tool is brought to the proper position to co-operate with the pattern bar and slide rest, substantially as is herein set forth."

5. For an *Improvement in the Construction of Bridges;* J. B. Gridley, Brooklyn, New York, July 6.

*Claim.*—"I am aware that diagonal or inclined counter braces, differently arranged, have before been used; such, therefore, irrespective of their disposition and combination as specified, I do not claim; but what I do claim as my invention is, the upper and lower counter braces, inclining in reverse directions to one another, for either half of the span, as shown and described, and connecting the double diagonal main brace with the upper and lower chords united by tie timbers as specified, producing the important results herein set forth."

6. For an *Improvement in Hand Planes;* Birdsill Holly, Seneca Falls, New York, July 6.

"The nature of this invention consists, 1st, in certain improvements in the stock, and in the cap of the iron, which allow the width of the throat to be altered for different kinds of work.

"2d, In certain means, by which the cap of the iron is always caused to drop into its place without requiring any adjustment or setting."

*Claim.*—"What I claim as my invention is, 1st, the loop on the cap, in combination with the plane iron and the stem of the stock, in the manner substantially as described, to wit: the said loop fitting over or embracing the plane iron and stem, and allowing the iron to be secured between the cap and the stem, by means of a wedge, placed either between the back of the iron and front of the stem, between the front of the iron and the cap, or between the back side of the stem and back part of the loop, the three positions of the wedge forming three different widths of throat, as herein explained.

"2nd, Providing the cap with shoulders, which, when the cap is placed in the stock of

the plane, will fall on suitable resting pieces, provided in or upon the stock, substantially as described."

7. For an *Improvement in Patterns for Metal Hubs, &c.;* Jasper Johnson, Geneseo, New York, July 6.

*Claim.*—"Having described my improvement, what I claim as my invention is, furnishing the usual pattern with a shield, as herein described, whereby I am enabled more easily to draw the core and prevent chipping and breaking down thereof."

8. For an *Improvement in Portable Grain Mills;* Charles Leavitt, Quincy, Illinois, July 6.

*Claim.*—"What I claim as my invention is, forming the inner stationary cone with a cavity, (square or otherwise,) as described, for the purpose of readily securing the mill on the top of a post or stump, without the use of bolts or wedges, &c., as set forth."

9. For an *Improvement in Churns;* Norman B. Livingston, Portland, Indiana, July 6.

*Claim.*—"Having thus fully described the nature of my improvement in churns, what I claim therein as new is, the racks, grooves, and pinions, by which the shaft and beaters are caused to traverse the milk or cream, with a compound vertical revolving and reciprocating motion, after the manner and for the purposes described."

10. For an *Improvement in Railroad Car Brakes;* Wm. Montgomery, Roxbury, Massachusetts, July 6.

*Claim.*—"I do not claim the mere combination of the plates or surfaces, one of which shall be made to rub against the other and constitute a friction brake; but what I do claim as my invention is, my improved brake, composed of three or any greater number of plates or disks, arranged side by side and on a shaft, and having some one or more of them connected with the shaft, so as to be revolved by it, and the others held stationary, so as not to be revolved, and the whole, except one of the outer ones, made to slide endwise on the shaft, and combined with an apparatus or means of pressing them towards and against one another, substantially as specified.

"I also claim the combination of the cross rods, with their friction plates and axle, for the purpose of sustaining the axle in case of fracture of it, as specified."

11. For an *Improvement in Processes for Defecating Sugar;* Robert and John Oxland, England, July 6, 1852; patented in England, May 15, 1851.

"These improvements consist in the combining of acetate of alumina, aluminate of lime, and phosphoric acid, for defecating saccharine liquids, or solution of sugar, and for removing their color."

*Claim.*—"Having thus described the nature of our improvements, and the manner of performing the same, we would have it understood that we do not confine ourselves to the details as herein given, nor to the phosphates mentioned, as others may be substituted; what we claim is, the use of aluminate of lime, in combination with the super-phosphate of alumina, or of lime, or with the phosphoric acid, for clarifying cane juice or syrups, as set forth: but we disclaim the use of phosphoric acid, except in combination with the above named bases."

12. For an *Improvement in Cutter Heads for Planing;* James M. Patton and Wm. F. Fergus, Philadelphia, Pennsylvania, July 6.

*Claim.*—"What we claim as our invention is, our improved elliptical reducing and planing instrument, composed of obliquely acting cutters, secured to an elliptical plate in such a manner that the periphery of the said plate will gauge the depth of the action of the cutters, and also serve to hold down the material operated upon, substantially as herein set forth."

13. For an *Improvement in Cordage Machines;* John W. Peer, Schenectady, New York, July 6.

"The nature of my invention consists in the combination of the scrolls and pinions, with friction pulleys, thereby producing regular feed motion, with an uniformity and equality of strain on each strand of rope, whilst laying or forming."

*Claim.*—"Having thus described the construction and operation of my machine, what I claim is, the use of grooved scrolls, and their combination with pinions, and grooved rollers, and friction rollers, or equivalents for such friction rollers, to create a regular feed motion and equality of strain, whilst laying or forming, in a rope, twine, or cordage ma-

chine; the whole being constructed in the manner and for the purpose substantially the same as described."

14. For an *Improvement in Double Acting Doors;* William Rippon, Providence, Rhode Island, July 6.

*Claim.*—"What I claim as my invention is, the manner substantially as herein described of arranging vertical and horizontal adjustable slats along the front, top, and back edges of the door, for the purpose of allowing the door being opened in either direction, in or out; said slats being made to operate in the manner herein specified, by means of the door, levers, or their equivalents, and springs; the whole being constructed and arrranged in the manner herein set forth."

15. For an *Improved Mode of Grinding Puppet Valves while the Engine is in Motion;* Enos Rogers, City of New York, July 6.

"The nature of my invention consists in a combination of certain mechanical elements, so adjusted and applied to the valves of steam engines while in use, that the valves thereby are caused to rotate slowly upon their seats during the period of time that they remain shut."

*Claim.*—"What I claim as my invention is, the valve provided with spindles free to turn on their lifters, in combination with mechanical devices, substantially such as are herein described, which rotate said valves when down on their seats, but do not act on said valves when rising or falling; the whole acting substantially in the manner and for the purposes described."

16. For an *Improvement in Machines for Rubbing Stone;* Pleasant E. Royse, New Albany, Indiana, and Ira Reynolds, Republic, Ohio, July 6.

*Claim.*—"We are aware that stationary or fixed wheels have been placed in the centre of stone rubbing machines, with cranked pinions revolving on their own axis and around the said fixed wheels as a common centre; therefore, we do not wish, or intend to claim, the arrangement of stationary or fixed wheels, around which the pinions revolve, to give motion to the arms and rubbers; but what we do claim as our invention is, the arrangement of a revolving centre driving wheel, with a series of stationary crank shaft pinions revolving on their own axis, whether in combination with the cranks or stationary pins, so constructed and arranged upon a radial line, as to give the arms and rubbers a rotary or compound elliptic rotary motion, for the purposes herein shown and set forth."

17. For an *Improved Combination of Cutters for Threading Wood Screws;* Thomas J. Sloan, City of New York, July 6.

"The nature of my invention consists in combining the operation of forming the threads of wood screws, by means of the burr cutter, with the operation of finishing and smoothing the thread, by means of a chaser, the screw blanks being in succession shifted from the operation of the burr cutter, where the thread is cut and formed, to the chaser, where it is finished, thus combining the advantages of both systems."

*Claim.*—"I do not wish to limit myself to the mode of construction of the various parts, or their arrangement, as they may be varied to a great extent, without changing the principle or mode of operation of my invention; what I claim is, the method, substantially as herein specified, of cutting away the mass of the metal to form the thread, by means of a burr cuttter, in combination with the method, substantially as specified, of finishing and smoothing the thread, by means of the chaser, as set forth."

18. For an *Improvement in the Thermostat for Regulating Heat;* Thomas J. Sloan, City of New York, July 6.

*Claim.*—"What I claim as my invention is, the application of the physical principle of the expansion and contraction of substances by varying degrees of heat, to regulate and control a mechanism, applied to operate a damper, register, valve, ventilator, or other equivalent device, which mechanism is actuated or propelled by some independent motor, substantially in the manner and for the purpose specified."

19. For an *Improvement in Pneumatic Spring;* Elijah Ware, Roxbury, Massachusetts, July 6.

*Claim.*—"Having thus described my improvements, what I claim as my invention in an air car spring, in which the piston operates upon the disk of rubber or other elastic substance which forms one side of the air chamber, is, the combination of the movable diaphragm,

constructed of the pieces, operating substantially as herein above described, with the rings placed loosely on the same, for the purpose herein set forth."

20. For *Improvements in Planing Machines;* William Watson, Chicago, Illinois, July 6.

*Claim.*—"Having thus described my improvements, what I specifically claim therein as new is, a reducing plane, composed of a series of oblique irons, arranged substantially as herein set forth.

"I also claim the combination of the before claimed reducing cutters with smoothing cutters, arranged substantially as herein set forth."

21. For an *Improvement in Railroad Car Brakes;* Lafayette F. Thompson, Charlestown, and Asahel G. Bachelder, Lowell, Massachusetts, Assignors to Henry Tanner, Buffalo, New York, July 6.

*Claim.*—"What is claimed by us is, to so combine the brakes of the two trucks with the operative windlass or their equivalents, at both ends of the car, by means of the vibrating lever, or its equivalent, or mechanism essentially as specified, as to enable the brakeman, by operating either of the windlasses to simultaneously apply the brakes of both trucks, or bring or force them against their respective wheels, and whether he be at the forward or rear part of the car."

22. For an *Improved Screw Threading Machinery;* Cullen Whipple, Assignor to the New England Screw Company, Providence, Rhode Island, July 6, 1852; ante-dated May 15, 1852.

*Claim.*—"What I claim as my invention is, a fusee, threading cutter for threading screw blanks, substantially as herein set forth.

"I also claim the arrangement of the cutter and blank, in such manner that the adjacent portions of their peripheries shall move in opposite directions during the operation of threading, so that the metal may be cut from the grooves in the blank from the bottom outwards, to allow the chip to be freely discharged, substantially as herein set forth.

"I also claim the combination of the vibrating feeding trough and screw driver, arranged in such manner that when the driver is pushed forward to turn a blank, while being threaded, an unthreaded blank may lie in the trough upon the driver, ready to drop into place before it, the instant it is drawn back, to allow the previous blank to be withdrawn from the cutter.

"I also claim the combination of the vibrating arm, or its equivalent, to detach the head of a threading blank from the bit of the screw driver, with a discharging punch, or its equivalent, to eject the threaded blank from the rest, the two thus operating, insuring the discharge of one blank before another is presented.

"Lastly, I claim a spring, or the equivalent thereof, in the mandrel of the screw driver, substantially as herein set forth, to impart to the bit of the screw driver, a slight yielding pressure against the head of the blank, until it winds and enters the nick thereof, in combination with the lever and cam, which afterwards apply to the driver a positive motion to keep it engaged with the blank while the latter is turned to be threaded, substantially as described."

23. For *Improvements in Machines for Tonguing Boards;* Samuel Albro, (late) Buffalo, New York, July 13.

"The nature of my invention consists in the making of a flaring stock, for the free escape of the shavings, and in combination therewith a series of cutters, so arranged as to cut a shaving both from the side and shoulder of the rebate, and giving to the said cutters a double grade, so as to be adjustable both to the side and shoulder aforesaid."

*Claim.*—"Having thus fully described my invention in tonguing, what I claim therein as new is, in combination with a flaring stock, substantially as described, the arranging of a series of cutters therein, so formed as to take the shavings from the sides and shoulders of the rebate, substantially as described; and this I claim, whether said cutters have a double or single graduation, so that I attain the result herein set forth, by substantially the arrangement and combination herein described."

24. For an *Improved Instrument for Driving Nails in Difficult Places;* Seth P. Carpenter, Milford, Massachusetts, July 13.

*Claim.*—"What I claim as my invention is, the instrument as constructed, of a combination of a tube, two or more springs, one or more holding points, and ramrod, and made to operate substantially as herein before specified."

25. For an *Improvement in Cast Iron Caissons;* James P. Duffey, Philadelphia, Pennsylvania, July 13.

*Claim.*—"Having thus described my invention, what I claim as new is, the method of bracing rectangular or other shaped metallic boxes, by means of the diagonal braces and rods, the braces and rods being arranged in the manner substantially as set forth."

26. For an *Improvement in Threshing Machines;* Joseph G. Gilbert, City of New York, July 13.

*Claim.*—"Having thus fully described the nature of my invention, what I claim therein as new is, the manner herein described of constructing skeleton threshing cylinders, viz: by bolting or welding to the arms, which are attached to the shaft, any suitable number of branches, which, together with the arms, present their edges to the line of motion, and are provided with serrated ends, substantially in the manner and for the purpose set forth."

27. For an *Improvement in Shingle Machines;* Furman Hand, Jr., Chicago, Illinois, July 13.

*Claim.*—"Having thus fully described my invention, what I claim as new is, so combining and arranging the riving knife and the shaving knives in their ways, as that, after the shingle has been separated, or nearly so, from the bolt, it will be carried forward by the carriage to the shaving knives, where it is finished, and so that the riving knife shall remain stationary, until the shaving knives have taken firm hold of the rived shingle; the whole being operated by the means substantially as herein described.

"I also claim, in combination, the double carriage, one moving on the top or over the other, and so arranged that one shall feed up the riven shingle to the knives, and the other shall carry back the bolt, at each operation of the machine, sufficiently far to cut off one shingle therefrom; the whole being operated substantially in the manner described."

28. For an *Improvement in Railroad Car Brakes;* Joseph P. Martin, Philadelphia, Pennsylvania, July 13.

"The nature of this invention consists in operating on the upper ends of the levers which move the rubbers of railroad car brakes, by longitudinal jointed bars, moving in guides at the will of the engineer, when the train is in forward motion, and projecting beyond either end of the car; the inner one of said bars being held in a suspended state, by means of a chain passing over a roller above the same, and around the shaft of the friction wheels, resting on the shaft of the wheels of the car, in such a manner as to enable the inner end of said inner bar to descend and clear itself of contact with the rubber levers, after the train has been checked, in order to back the same, and to be raised to its former position for acting, after the train has been moved a certain distance ahead."

*Claim.*—"What I claim as new is, the method of raising the forked or cam hook end of the jointed bar to a horizontal position, immediately in advance of the pin, at the upper end of the rubber levers, so that it will act upon the same when forced back, and enabling it to detach itself and descend to an inclined position, when it is desired to back the train, by means of the friction wheels, whose shaft moves in slots, and whose peripheries rest on the car wheel shaft or axle and chain, attached to the shaft of the friction wheels, and passing over the roller above the jointed bar, to which it is attached, arranged and operated as herein described, whether the said jointed bar be attached to the sliding bar represented, or to the ordinary bumper of the car."

29. For an *Improvement in Churns;* John McLaughlin, Goshen, Ohio, July 13.

*Claim.*—"I am aware that oscillating churns have been used before; therefore this I do not claim: but what I do claim as my improvement is, mounting the churn tub or barrel, composed of two sections, and containing a grate at their junction, within a clasp band, united to pivoted pendent bars, whereby, through means of a lever, the barrel is so operated as to present its ends uppermost, the one after the other, by which the milk or cream is carried up by one section, and allowed to descend through the grate, as described."

30. For an *Improvement in Shingle Machines;* Robert L. Noblet, Haverford, Pennsylvania, July 13.

*Claim.*—"Having thus fully described my invention, what I claim therein as new is, making the double racks in segments, one of which is stationary, and the other adjustable, for the purpose of cutting shingles of various thicknesses at butt and point, with the same racks, substantially as described."

31. For an *Improvement in Benzole Lights;* Henry M. Paine, Worcester, Massachusetts, July 13.

*Claim.*—"I do not lay claim to any particular apparatus; but what I do claim as my invention or discovery is, the mixture of alcohol, benzole, and water, with such proportions of water as shall render the liquid milky in appearance, and passing air through the same, substantially as herein set forth. I do not confine myself to the exact proportion of water named in the specification, but to cover the results herein named."

32. For an *Improvement in Corn Shellers;* William Reading, Washington, District of Columbia, July 13.

*Claim.*—"Having thus fully described my improved corn sheller, what I claim therein as new is, the within described combination of a toothed or flanched cylinder, with an enclosing cylindrical casing, of such proportions respectively, and so arranged, the one within the other, as to leave an amount of space between the two which shall cause the cobs and ears to clog and accumulate therein, during their passage through the same, and form an elastic self-adjusting bed, for the spirally arranged teeth or flanches of the shelling cylinder to act in concert with, in place of the stationary bar or rest, which is employed in all other cylindrical corn shellers."

33. For an *Improvement in Cast Iron Car Wheels;* Hiram H. Scoville, Chicago, Illinois, July 13.

*Claim.*—"Having thus described my improved car wheels, what I claim as new therein is, the double curved arms interlacing one another, and uniting the opposite edges of the rim and hub, substantially as specified."

34. For an *Improvement in Bedstead Fastenings;* Isaac A. Sergeant, Hamilton, Ohio, July 13.

*Claim.*—"Having thus fully described the nature of my invention, what I claim therein as new is, forming the tenon portion of a bedstead joint by catch-studs or pins, having heads projecting rectangularly from tangs, so tapered and notched, that by being slipped forcibly past each other, they can be made to interlock within a socket, drilled for them, across the radial or bastard grain of the rail tenon, and be made, by their thus interlocking, to resist any tendency to be drawn out from the rail, and by the compressure of their heads, to prevent the rending apart of the fibre of the tenon, and can be made of such dimensions that a pin of adequate strength can be inserted within the limits of an ordinary bedstead tenon."

35. For an *Improvement in Alarm Clocks;* Jonathan S. Turner, New Haven, Connecticut, July 13.

"My improvement consists in so constructing the alarm part, that it will give alarms for eight days (or more) with once winding, and so that it will give but one alarm in twenty-four hours, or while the hour hand is making two complete revolutions."

*Claim.*—"What I claim as my invention is, the combination of the double notched cam, with the locking apparatus, with their appendages, and giving more than one alarm with once winding, when the whole is constructed, arranged, and combined, substantially as herein described."

36. For an *Improvement in Cotton Presses;* Jacob G. Winger, Vicksburgh, Mississippi, July 13.

"The nature of my invention consists in constructing a press with two right hand and one left hand screws, or two left hand and one right, as herein after described, so as to give three times the progressive motion to the follower, in the same time, that would be effected by a single screw; and so arranging it, that the entire weight of the frame and chamber of the press is made effective to aid in pressing the bale."

*Claim.*—"Having thus described my invention, what I claim therein as new is, the arrangement and combination of the screws with the top and bottom cross beams of the frame, and the cross head of the follower, by which the follower and bed plate are made to press the bale from top and bottom, and the distance traveled by the follower towards the bed plate is three times that of the frame (to which the power is applied) over the screw.

2d, I claim making the weight of the press an auxiliary power, by resting it entirely on the lower screw, so that in pressing the bale, the frame is traveling down the screw, as on an inclined plane."

37. For an *Improvement in Seed Planters;* Joshua Woodward, Haverhill, New Hampshire, July 13.

*Claim.*—"Having thus fully described my improved seeding apparatus, and the various modes I contemplate modifying it, as required by law, what I claim therein as new is, the hooked rod, constructed and arranged substantially in the manner and for the purpose set forth."

38. For an *Improvement in Door Locks;* Marcus R. Stephenson, Assignor to Edwin Holman, Boston, Massachusetts, July 13.

*Claim.*—"I claim the combination of the cover plate and its arbor, with the slide for carrying the bitt plate, and a contrivance applied to the said arbor, and made to actuate the said slide and bitt plate, all constructed and made to operate together substantially as herein before described.

"And I also claim the improvement termed the circular arc lip, in its combination with the cover plate, and made to project down between the bitt plate recess and the tumblers, when the bitt plate hole or entrance of the cover plate uncovers the bitt plate recess, either in whole or in part, all substantially as herein before explained."

39. For an *Improvement in Fire Engines;* Orville G. Adkins, Oswego, New York, July 20.

*Claim.*—"What I claim as my invention is, the mode herein described, of drawing the resistance towards the fulcrum of the lever to which the power is applied through its entire descent; thereby lengthening the long arm, and shortening the short arm of the lever, substantially as described."

40. For an *Improvement in Car Seats;* William S. Bass, Cambridge, Massachusetts, July 20.

"The object of my improvements is, to secure an easy and comfortable car seat, so constructed as to admit of a person's reclining as far back as is desirable, while at the same time it will occupy no more room than those which have heretofore been in common use."

*Claim.*—"Having thus described my improvements, what I claim as my invention is, a car seat, to the bottom of which are jointed a back and leg support; the said back and leg support being placed and held at any desired angle, by arms fastened to the side arms in any desirable way, as above set forth."

41. For an *Improvement in Ploughs;* Neri Blatchly, Windsor, New York, July 20.

*Claim.*—"What I claim as my invention is, the arrangement of the beam of a plough with respect to the irons, and the bending of the standard towards the land, and having its line of direction parallel with that of the land side, in the manner and for the purposes herein set forth."

42. For *Improvements in Machines for Shaving Shingles;* Abel Bradway, Monson, Massachusetts, July 20.

*Claim.*—"Having thus fully described my improved machine for dressing riven shingles, what I claim therein as new is, the combination and arrangement of the yielding knives, the sliding shingle patterns, the roller, the elastic bed, the plate, and box, substantially in the manner and for the purpose as herein set forth."

43. For an *Improvement in Method of Converting Reciprocating Rotary into Reciprocating Rectilinear Motion;* Alfred Carson, City of New York, July 20.

*Claim.*—"I do not claim the use of pulleys, chains, and guides, for the purpose of converting rotary reciprocating into rectiliner reciprocating motion; but what I do claim as my invention is, slotting or forking the rods, and letting their two sides into grooves in the periphery of the pulley, and connecting the rods and pulley by three chains, two of which connect with each rod on opposite sides, and pass in one direction around the pulley, and the other connects with each rod within the slot or fork, and passes in the opposite direction round the pulley, for the purpose of guiding and directing the rods, and dispensing with the ways and cross heads ordinarily made use of for this purpose; the several parts operating substantially as and for the purpose set forth."

44. For an *Improvement in Machines for Dressing Stone;* Robert Eastman, Concord, New Hampshire, Assignor to Capt. Seth Eastman, Washington, District of Columbia, July 20.

"The nature of my invention consists in dressing or working the stone or other material

by forcing the chisels, picks, or cutters against it, by a positive crank motion, so that they cut with a steady positive motion, under the combined action of the crank, instead of cutting with a blow."

*Claim.*—"What I claim as new in the within described machine for dressing stone, and for facing, reeding, fluting, and cutting mouldings upon stone, is the operating of one or more chisels or tools, by a crank or cranks, or their equivalents, which, by their continued action upon said tools, thrust or force them against the stone or other material to be worked, substantially as described."

45. For an *Improvement in Cruppers for Harness;* John J. Flack, Joliet, Illinois, July 20.

*Claim.*—"What I claim as my invention is, the construction of a crupper, as herein described, by means of which, in taming or subduing horses, the tail of the horse may be kept in a desired position, without the necessity of resorting to the painful and injurious operation of nicking or pricking, and the pulleys, and to be used for the same purpose, when riding or driving the horse."

46. For an *Improvement in Grain and Grass Harvesters;* Eliakim B. Forbush, Buffalo, New York, July 20.

*Claim.*—"I claim as my invention, 1st, an open spaced guard finger with an inside surface, or middle finger, for the cutting tooth to cut against, substantially as herein described.

"2d, I claim the construction of a clamp of two parts, which will hold the finger bar, where desired, without bolts passing through the finger bar, arranged as herein set forth.

"3d, I claim the construction of a mould board with two upright posts, which posts pass through proper apertures in the frame of the machine, and are free to move up or down, according to the varying surface of the ground, and sustain the mould board forward of the cutter bar, on an angle sufficient to move the mown grass which may be forward of the finger bar to the inside of the clamp, substantially as herein described.

"4th, I claim the arrangement and combination of a right angled stanchion, made of wood or metal, with a pivotal motion on the frame work of the machine, and supporting upon its upright part a crooked lever made of wood or metal, with a pivotal motion on the said stanchion, to which lever is attached a rake; by the combination and operation of these two pivotal motions of the stanchion and lever, as set forth, a direct line motion may be given to the rake where needed, as also a circular motion, so that a person may remove the grain from the platform in bundles, and sit or stand on the machine near the driving wheel, as herein described."

47. For an *Improvement in Railroad Car Brakes;* Wm. Hall, North Adams, Massachusetts, July 20.

*Claim.*—"What I claim as of my invention is, the combination of the sliding detached lever with the main lever and the connecting rods, so as to operate essentially in the manner and for the purpose as herein before specified."

48. For an *Improvement in Rice Hullers;* Clark Jacobs, Brooklyn, New York, July 20.

*Claim.*—"I do not claim the use of india rubber surfaces for hulling the rice, such having been used before; but what I do claim as my invention is, the use of a vulcanized gum elastic, or rubber, or its equivalent, in combination with a stone or other equivalent non-elastic rubbing surface, for hulling rice, substantially in the manner herein set forth.

"I also claim the manner of constructing the rubber of three substances of different qualities, viz: the metallic disk, leather disk, and gum elastic, or gutta percha disk, by which firmness, elasticity, and durability are combined, substantially as herein described."

49. For an *Improvement in Grass Harvesters;* Jesse S. and David Lake, Smith's Landing, New Jersey, July 20.

*Claim.*—"What we claim as our invention is, 1st, The clearer as above described.

"And lastly, we claim the coupling the wheel to the shaft, with universal joint, constructed with toggle joint arms, to admit of a vertical motion, and with gimble ring, to allow of a rolling or wabbling movement, without affecting its rotary motion, when combined and arranged for the purpose and in manner above described."

50. For an *Improvement in Grass Harvesters;* Wm. Manning, South Trenton, New Jersey, July 20.

*Claim.*—"Having thus fully described my invention, what I claim as new is, suspend-

ing the cutting head and front part of the machine, whereby I dispense with front wheels, by constructing the frame as described, and attaching the cutting head to the hames of the harness, in the manner and for the purpose herein fully set forth."

51. For *Improvements in Sewing Machines;* Charles Miller, St. Louis, Missouri, July 20.

"This invention relates to that description of sewing machine which forms the stitch by the interlacing of two threads, one of which is passed through the cloth in the form of a loop, and the other carried by a shuttle through the said loop; it consists, 1st, in an improved stop motion, or certain means of preventing the feed or movement of the cloth, when by accident the thread breaks or catches in the seam; and, 2d, in certain means of sewing or making a stitch similar to what is termed in hand sewing, 'the back stitch.' "

*Claim.*—"Having fully described my invention, what I claim as new is, 1st, The stopping or prevention of the operation of the feed, substantially as herein described, when the thread breaks or is otherwise prevented from forming a loop, by attaching the stud or its equivalent, through which the feed lever is operated upon by the feeding cam, to a lever; the said lever being subject to be operated upon in such a manner as to withdraw the said stud, or equivalent, from the operation of the cam, by a sliding piece attached to the picker, which drives the shuttle forward for filling; the said sliding piece requiring to be caught and moved by every loop, to prevent its operation in the said lever.

"2d, Sewing or making the back stitch by folding or bending the cloth or material over the edge of a guide plate or any other suitable edge, and passing each loop through the cloth or material on each side of the said bend and each succeeding loop through, in advance of the preceding one, and half-way between the two preceding perforations, substantially as herein set forth."

52. For an *Improvement in Grain Separators;* Cyrus Roberts, Belville, Illinois, July 20.

*Claim.*—"Having thus described my improvements in grain separators and cleaners, what I claim therein as new is, the combination of the adjustable crank for vibrating the separating trough, with the adjustable tracks on which the jumping roller runs, which shakes the trough up and down, whereby the conveyance of the straw may be accelerated or retarded, without affecting the vertical shaking of the straw.

"I also claim the adjustable angular rails, constructed and arranged in the separating trough, in the manner and for the purposes herein set forth.

"I likewise claim the method herein described, of relieving the winnowing apparatus of a portion of the work, by separating, by means of a screen, arranged substantially as herein set forth, such impurities as will pass through it before the grain is delivered to the winnowing apparatus."

53. For an *Improvement in Railroad Car Brakes;* John Houston and Ebenezer Ross, Manchester, New Hampshire, July 20.

*Claim.*—"What we claim as our invention is, the arrangement, substantially as set forth, of the levers, rods, and vertical shaft, applied to each truck of a railroad car, in combination with the method of connecting the levers by means of the links, so that if one or more of the links or bars should break, so as to render part of the brakes useless, the remainder are still serviceable for the purposes intended."

54. For an *Improvement in Machines for Rubbing Stones;* Pleasant E. Royse, New Albany, Indiana, July 20.

*Claim.*—"I do not claim the separate employment of a rotary rubber and blocking tables, as such are in common use; nor do I claim, of itself, giving the rubbers a separate motion, in addition to their revolving one, by means of pinions gearing into a fixed wheel, and through cranks and connecting rods, serving to operate the rubbers, as such has before been done; but what I do claim as my invention is, the combination of parts herein specified, for rubbing and polishing marble or other stone, consisting of rubbers, having in addition to their revolving travel on the faces of the stones being rubbed or polished, a motion in and out from the centre shaft, not in a radial, but in a winding, twisting, or curvilinear direction, produced by the cranks and rods as shown and set forth; the said rubbers being held in clamps, so hung or connected, as that the rubbers, by their weight, will adjust themselves to the stone, without rendering it necessary to pack up the latter, and for the further advantages specified."

55. For an *Improvement in the Water Pipes of Tuyeres;* Peter Sweeney, Buffalo, New York, July 20.

"The nature of my invention consists in combining with the circulating water pipe for cooling the tuyere, another pipe, by which I am enabled to shut off the circulation of water and blow the water out of the circulating pipe; the object of my invention being to avoid the evils which arise from the freezing of the water in the circulating pipe of the tuyere in cold weather."

*Claim.*—"What I claim is, the combination of the pipe, H, with the circulating pipe, P, V, Q, so connected that H may be removed from, or form a water tight joint with P, V, Q, whereby I am enabled to blow all the water out of the latter, and at the same time to shut off its communication with the cistern, in the manner and for the purposes described."

56. For an *Improvement in Railroad Car Coupling;* James Turner, East Nassau, New York, July 20.

*Claim.*—"What I claim as my invention is, the transverse incline bar, in combination with the coupling pin and link, the pin resting on the incline bar, and being raised clear of the link, by passing up the inclines on the said bar, as it (the pin) moves sideways, substantially as herein described."

57. For an *Improvement in Preparing Zinc from the Ores;* Henry W. Adams, City of New York, July 27.

*Claim.*—"Having thus fully described the nature of my invention or discovery, and shown the method in which it may be accomplished, what I claim therein as new is, the process of manufacturing metallic zinc, in a state of impalpable powder, by the cooling agency of steam, substantially in the manner herein set forth."

58. For an *Improvement in Machines for Forming Button Backs;* James C. Cooke, Waterbury, Connecticut, July 27.

*Claim.*—"What I claim as my invention is, the jointed clamps, and the tongue, to form the eye, when combined with the slide with its stationary and movable jaws, when the movable jaw and slide are worked by a jointed lever to feed the wire, when they are constructed and made to operate substantially as herein described.

"I also claim the die for punching and forming the button back, composed of the punch and bed, when combined with the slide and feeding cylinder, when constructed and operated substantially as herein described.

"I also claim the jointed fingers for receiving the formed and punched back, and conveying it to and placing it on the eye, when combined with the setting or riveting punch, when they are constructed, combined, and arranged, and made to operate, substantially as herein described."

59. For an *Improvement in Saws for Sawing Stone;* Albert Eames, Springfield, Massachusetts, July 27.

"The nature of my invention consists in making the blade with the middle part of its thickness, of lead or other soft substance, so that sand shall become imbedded into it, and remain there during the operation, to act upon, and break down, or cut away the stone, whilst the sides or edges, which are made of steel or iron, or other hard metal, will cut down and keep the kerf of the proper width, and prevent the lead or other soft substance, from spreading out or yielding."

*Claim.*—"What I claim as my invention in the making of blades for cutting stones is, the employment of lead, or its equivalent, between and in combination with the hard metal sides, substantially as specified."

60. For an *Improved Churn and Butter Worker;* Orsamus R. Fyler, Brattleborough, Vermont, July 27.

"The nature of my invention consists in combining revolving floats or dashers, with stationary posts, between which the dashers revolve."

*Claim.*—"What I claim as my invention is, 1st, the combination, in a cylindrical or tub churn, of floats or paddles, attached to a revolving axis, with stationary posts standing near the axis of the churn, combined and operating in the manner and for the purpose above specified.

"2d, The combination of dashers, or paddles, broad at their ends, with posts small at each end, and large in their middle portions, combined and operating in the manner and for the purpose above specified."

61. For an *Improvement in Fastenings for Harness;* Thomas Henderson, Harford County, Maryland, July 27.

*Claim.*—"Having thus fully described my invention or improvement, I wish it to be understood that I do not claim, in general terms, the use of a crooked lever and ring, for these have been applied before to this purpose; but I do claim as new, the use of this peculiar kind of crooked lever or hook, described above, in which the fulcrum and centre of motion are at the short end, and the point of resistance at the curve and in a straight line with the fulcrum and other end, thereby effecting the desired object within itself, and without the combined aid of plate, spring, rivet, or other fixture; whether the same be applied to the fastening of hames, as described above, or to connecting the ends of chains, as in the case of chains usually fastened across the middle of wagon bodies, or to any similar purpose."

62. For an *Improvement in Duplex Escapements;* Charles E. Jacot, City of New York, July 27.

*Claim.*—"I do not claim any of the parts herein described or shown; nor do I claim the duplex escapement; but what I do claim as new and of my own invention is, the construction and arrangement of the escapement wheel with three points and pins to take the arm on the balance axis; the whole being constructed and operating substantially as described and shown."

63. For an *Improvement in Seed Planters;* Adam Kraber, York, Pennsylvania, July 27.

*Claim.*—"What I claim as my invention is, the combination of a series of stationary combs, secured to the bottom of the hopper, near the orifices, through which the grain is discharged with a corresponding series of rotating teeth, secured to a cylinder or roller, that revolves within the hopper, in the manner and for the purposes herein set forth.

"I also claim the combination of the cross bar, and its links and levers, with the draft bars of the shares, whereby the whole series of shares can, at will, be raised and depressed, while the machine is in motion, and the weight of the whole machine is brought to bear upon any tooth that may tend to run out, in consequence of meeting with hard soil, while, at the same time, an even depth of furrow is maintained by the wheels, and the weight of the frame taken off the shares, except when some one of them tends to run out, as herein set forth; but I make no claim to any arrangement of mechanism, for holding the teeth or shares in the ground, when the pressing bar acts upon the teeth through the medium of springs."

64. For an *Improvement in Soaps;* William M'Cord, City of New York, July 27.

*Claim.*—"I am well aware that "fuller's earth" being used for a soap, from time immemorial, also of various clays having been used for detergent purposes; I am also aware that ammonia has been employed in soap, and a patent has been issued, in which it forms one of the ingredients; but in all cases, so far as I have seen it used, it has never been held in good combination with the other ingredients in the soap, but has, owing to its volatile nature, soon evaporated. As combined with the clay, by my process, the ammonia is retained in the soap, and does not evaporate. What I therefore claim is, the combination of ammonia, or carbonate of ammonia, with kaolin, or other equivalent aluminous minerals, in the composition of a soap, substantially as herein set forth."

65. For *Improvements in Railroad Track Clearer;* Simeon Minkler, Chazy, New York, July 27.

*Claim.*—"I do not claim the grapples which are attached to the engine, car, or carriage, and embrace the top flanch of the rail; but what I do claim is, keeping the said grapples closed upon the flanch of the rail, by the collar which drops over their joints, and opening the same by chains, or their equivalents, attached to the said collar and to the grapples, under the control of a person on the engine, car, or carriage, said chains or equivalents lifting the collar, so as to leave the grapples free, and then opening them, substantially as herein set forth."

66. For an *Improved Block for Stretching Coats;* Samuel M. Perkins, Springfield, Pennsylvania, July 27.

*Claim.*—"Having now described my invention, what I claim is, the use of the seamless coat stretcher, made in two halves and joined together by hinges at their back edges, and having permanent or adjustable arms attached thereto, and hooks for holding the edges of the cloth, while stretching, spring hook, or catch and pin, for holding the halves of the machine together, and steadying pins, in the face of the two halves, in combination therewith, substantially as set forth."

67. For an *Improvement in Railroad Car Seats;* Samuel M. Perry, City of New York, July 27.

*Claim.*—"What I claim as my invention is, to so combine the back with the two end frames by means of bars jointed to it, one or two studs, and one or two series of notches or equivalents therefor, that the said back (when not a reversible one) may be raised and inclined in various positions, so as to not only support the back but the head of a person at the same time.

"And I claim making the back reversible by means of two series of notches, and two sets of studs, or equivalents, the same being arranged on opposite sides of the chair, and made to operate as specified.

"And in combination with the back made to raise and be inclined, by contrivances substantially as specified, I claim the improvement of making each bar with a rack or racks of teeth, or succession of notches, to be set on the pin, in the manner and for the purpose as specified."

68. For an *Improvement in Mortising Machines;* William C. Shaw, Madison, Indiana, July 27.

"The nature of my invention consists in providing the machine with suitable mechanism, for the purpose of enabling the operator to turn the chisel by means of the machinery employed for the purpose, and not by hand, as is commonly done."

*Claim.*—"What I claim as my improvement is, the method I employ of turning the mandrel that contains the mortising chisel, by means of the collar on the mandrel, springs, catches, shifting piece, friction rings, and pinion, all in combination for the purpose heretofore mentioned and set forth in the foregoing specification."

69. For an *Improvement in Lamps;* Charles Siedhof, Lancaster, Massachusetts, July 27.

*Claim.*—"What I claim as my improvement is, the open slide tube, as combined with the supply reservoir of a lamp, constructed and made to operate substantially as described; the object of such tube being not only to maintain the oil at a constant level around the wick, but to enable a person to regulate the height of such level at pleasure."

70. For an *Improvement in Graduated Cutters for Cloth and other Substances;* Halsey D. Walcott, Boston, Massachusetts, July 27.

"This improvement consists in making the bed longitudinally adjustable, in relation to the cutter, (or vice versa,) so as to vary the length of the cutting edge, which shall come in contact with the bed, and consequently the length of the incision that will be made by them."

*Claim.*—"What I claim as my invention is, the employment of a cutter and bed, or their equivalents, made adjustable in relation to each other, in the direction of the cutting edge, for the purpose of varying the length of the cut, substantially in the manner herein described."

71. For an *Improvement in Compounds for Uniting Steel and Iron;* Boyd C. Leavitt, Assignor to Joseph H. Bishop and H. Libbey, Newport, Maine, July 27.

*Claim.*—"I wish it understood I do not claim the use of crude borax, either pulverized or not, for the union of metals, as this has been used for the purpose by others; but it does not insure a perfect union, and cannot be relied upon with any degree of certainty, and great loss of time and material often occur, as a ready separation of the two, even after a seeming union, and the particular work seems complete, and ready for the use intended; but what I do claim as my invention or discovery is, the mode and manner of calcining and preparing the crude borax, and compounding the same afterwards, with the carbonate of ammonia, and in the proportions above set forth and described, and the mode of applying or using it, or any other substantially the same, and which will produce the intended effect."

72. For an *Improvement in Brooms;* Cyrus T. Moore, Assignor to Friend S. Noyes, Concord, New Hampshire, July 27.

*Claim.*—"What I claim as my invention is, 1st, securing the material of the broom, by means of a clasp having its jaws hinged at the extremities, and fastened together at the socket, or some equivalent device, substantially as herein set forth.

"2d, A spring or springs, whether placed as herein described, inside of the brush or material composing the broom, or otherwise, so as to operate in substantially the same manner.

"3d, The cross, fastened to the spring with spurs, or otherwise, in combination with the loop, to hold the brush or other material in its proper place, as described."

RE-ISSUES FOR JULY, 1852.

1. For an *Improvement in Bedsteads;* Nathaniel Colver, Abington, Massachusetts; patented April 24, 1849; re-issued July 6, 1852.

*Claim.*—"I lay no claim to a combination of rest bars or boards, spiral or wound wire springs, a sacking and closing frame, used to support a cushion or mattress; such a combination having been employed in the manufacture of sofas and other articles of furniture: but what I claim as my invention is, the method in which I construct the foundation of the bed or mattress, by means of the above described pliances or their equivalents, to wit: the lacing and the clamps and keys, or wedges, so as to render the bedstead portable, by being taken apart, or enfolded, the one part over the other, or united together, or unfolded, as above described, as occasion may require, that is to say, I claim the combination of the two frames, or halves of a box, each of said frames or halves consisting of a side, two ends, and bottom, or slats, supporting wire springs, and a sacking affixed to its side and two ends, and supported on springs or stuffing, as occasion may require, and these halves or parts so united that when together, or unfolded, they form but one box or frame, supporting or holding fast the sacking at its entire extremity, without any separating or supporting partition in the centre, and this union or junction of the two posts is effected by the above described lacing, or its equivalent, and clamps and keys or wedges, or their equivalent.

"I lay no claim to any one of the elements of the aforesaid or above described combinations, when separate from the rest; but intending only to claim the whole, as combinations, constituting a bedstead, or foundation for a bed or mattress, to which the parts as above described, or their equivalents, may be applied as aforesaid."

2. For an *Improvement in Machines for Tonguing Boards;* Ransom Crosby, Jr., Assignee of Ransom Crosby, Assignee of Henry D. Edgcomb, City of New York; patented April 13, 1852; re-issued July 13, 1852.

*Claim.*—"I am aware that Harvey Law has described in his patent of 10th April, 1849, a mode of tonguing, in which two sets of saws are arranged in a frame, with the cutting teeth opposite, and cutting in one plane on opposite faces of the board; none of which devices we desire to claim. But what I do claim as the invention of Crosby and Edgcomb is, the employment of two independent sets of independent cutters, arranged in parallel planes in parallel stocks, with an open space between them, so as to cut on the edge of the board, all in the manner substantially as described, whereby I have the advantage combined of freedom from clogging, and the facilities of adjusting the stocks and cutters for sharpening, setting, and inspection."

DESIGNS FOR JULY, 1852.

1. For a *Design for a Parlor Stove;* Jeremiah D. Green, Assignor to Alexander Morrison and Thomas M. Tibbitts, Troy, New York, July 6.

*Claim.*—"What I claim as new is, the ornamental design and configuration of a parlor stove, the same as herein described and represented in the annexed drawing."

2. For a *Design for a Cooking Stove;* Wm. F. Pratt and Geo. W. Bosworth, Milford, New Hampshire, July 13.

*Claim.*—"What we claim as our invention or production is, the ornamental design for a cooking stove, substantially as represented in the accompanying drawings.

"And we also particularly claim the combination of the star, shield, and radial lance heads, as exhibited in the panel of the larger door of the side plate."

3. For a *Design for a Cooking Stove;* Saml. D. Vose, Albany, New York, July 13.

*Claim.*—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the combination of the several mouldings and ornaments, as arranged together, the whole forming an ornamental design for an air tight cook stove, as herein set forth and described."

4. For a *Design for a Hat and Umbrella Stand;* Charles Zeuner, Assignor to M. Greenwood & Co., Cincinnati, Ohio, July 13.

*Claim.*—"What I claim as my invention is, the new design for a hat and umbrella

stand, consisting of the ornamental figures above set forth and represented in the accompanying drawings."

5. For a *Design for a Portable Grate;* Apollos Richmond, Assignor to A. C. Barstow & Co., Providence, Rhode Island, July 13.

*Claim.*—"What I claim as my production is, the new design, consisting of the gothic arches, mouldings, pendants, &c., herein above described and represented in the drawings, for a portable grate."

6. For a *Design for Parlor Stove Plates;* Amos Paul, South Newmarket, New Hampshire, July 20.

*Claim.*—"What I claim as my production is, the new design, consisting of the mouldings, raised points, vine and leaf work, herein above described and represented in the drawings, for the top, bottom, and side plates of a parlor stove."

7. For a *Design for the Front and Side Plates of a Cooking Stove;* Dutee Arnold, Providence, Rhode Island, July 27.

*Claim.*—"What I claim as my production is, the new design, consisting of the mouldings, spear heads, and stars, with rosettes, herein above described and represented in the drawings, for the front and side plates of a cooking stove."

8. For a *Design for a Medallion of Daniel Webster;* Peter Stephenson, Boston, Massachusetts, July 27.

*Claim.*—"What I claim is, the design of a medallion of Daniel Webster, as represented in the drawings above referred to."

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ADDITIONAL IMPROVEMENTS, FOR JULY, 1852.

1. For an *Improved Process for Mashing Maize;* Frederick Seitz, Easton, Pennsylvania; patented June 20, 1852; additional improvement dated July 13, 1852.

*Claim.*—"Now what I claim as my additional invention, and desire to add to my former patent, granted January 20th, 1852, is, forcing cold air into the distillery mash, through the hollow shaft arms and rakes, agitators, as above described, or by forcing it by a pipe or pipes into the bottom, or near it, of any common mashing machine or tub."

2. For an *Improvement in Metallic Heddles;* Jacob Senneff, Philadelphia, Pennsylvania; patented January 13, 1852; additional improvement dated July 20, 1852.

*Claim.*—"Having thus described my improvement, what I claim as my invention, and desire to have added to my patent, is, casting eyes of harness or heddles upon single or multiplied strands of worsted, silk, cotton, thread, or other material, in the manner and for the purpose herein set forth."

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## AUGUST.

1. For an *Improvement in Railroad Car Seats;* Charles P. Bailey, Zanesville, Ohio, August 3.

"The nature of my invention consists in combining with a permanent seat, a divided back, so arranged as that each part shall swing around the end of its respective part of the seat, when it becomes necessary to reverse the backs, and so that both parts of the back may be reversed, or only one part, leaving the occupants to sit tete-a-tete."

*Claim.*—"Having thus fully described my invention, what I claim therein as new is, in combination with a permanent seat or seats, a divided back, which is so constructed that one part thereof shall swing around one end of the seat, and the other part around the other end thereof, the back retaining always its upright position, and by which arrangement the two parts of the back may be entirely reversed, or they may be left tete-a-tete, substantially as herein described."

2. For an *Improvement in Looms for Weaving Figured Fabrics;* Cornelius W. Blanchard, Clinton, Massachusetts, August 3.

*Claim.*—"I do not claim the application of the above named levers to the trap or knot boards of the jacquard loom; but what I do claim therein as new is, 1st, The opening or raising and depressing the harness, by means of levers or bars, oscillating about a fixed point or points, in connexion with hooks or their equivalents, which catch upon these levers or bars, and which constitute a part of the connexions between the top and bottom

jack levers, cords, or other devices, for raising and drawing down the harness, thus raising or depressing the heddles, in a greater or less degree, according as they are more or less distant from the fell, or cloth making point, the motions of the harness all commencing and ending at the same time, as herein substantially described.

"I also claim the method as described, of arranging and combining the parts for moving the figuring chain or cylinder with the other parts of the machine, so as to carry the said chain or cylinder back as well as forward, as the machine is made to move backward and forward."

3. For an *Improvement in Pressure Gauges;* Eugene Bourdon, Paris, France, August 3; patented in France, June 18, 1849.

*Claim.*—"Having now described my invention, I wish it to be understood that I claim the application of curved or twisted tubes, whose transverse section differs from a circular form, for the construction of instruments for measuring, indicating, and regulating the pressure and temperature of fluids, substantially as above described."

4. For an *Improvement in Dumping Wagons;* Thomas Castor, Frankford, Pennsylvania, August 3.

"My invention consists in balancing the body of a wagon, at or about its centre, on a roller that projects upward from the frame of the running gear, and serves as a fulcrum and sliding point for the body to turn and run on, to facilitate the dumping of its load, and its replacement in the loading position."

*Claim.*—"Having thus described my improved dumping wagon, what I claim therein as new is, the arrangement of the body on a fixed roller fulcrum on the frame of the running gear, in such manner that by a slight amount of force the body can be turned, to give its under side, which rests on the roller, either a forward or backward inclination, to cause the weight of its load to tend to hold it forward or back, as it is required to carry or to dump the same, substantially as herein set forth."

5. For an *Improved Tally Board;* Francis N. Clark, Chicago, Illinois, August 3.

"The nature of my invention consists in having a series of screw rods properly secured over a board, said screw rods having nuts upon them, which are moved either to the right or left, according as the rods are turned upon the board, and underneath each nut there is a space, which is graduated in any proper manner; by turning either screw rod, the nut on the rod is moved, and the graduated space shows how far the nut has moved and the amount tallied."

*Claim.*—"I do not confine myself to any particular form or manner of arranging the screw rods over the board, nor to any particular manner of graduating the spaces; but what I claim as new is, the manner of tallying or keeping an account of articles, as they are delivered or moved, by means of screw rods, having nuts upon them, said nuts being placed over graduated spaces, which indicate the distance the nuts have moved, or give the number of turns or half turns of the rods; the rods, nuts, and spaces being arranged as shown and described, or in any other manner substantially the same."

6. For an *Improvement in Casting Stereotype Plates;* Hobart P. Cook, Albany, New York, August 3.

"The nature of my invention consists in using, by means of appropriate mechanical arrangement, the power of compressed air or of steam, in the casting of stereotype plates; thereby insuring greater rapidity in the process of casting, with a decreased liability of injury to the plates while being cast, and at a much reduced cost of production."

*Claim.*—"What I claim as my invention is, the manner of casting stereotype plates, by the application of pressure upon the surface of the melted metal in the inner kettle, which pressure forces the metal, while fluid, through a tube and upon the mould, the face of the mould being turned down to receive the metal making the casting; the whole acting substantially in the manner and upon the principles set forth and described in the specification."

7. For an *Improvement in Compositions for Preserving Butter;* Louis De Corn, Cincinnati, Ohio, August 3.

"By my process, any quantity of butter can be preserved, indefinitely, fresh; I mean, can be preserved always fresh for any length of time."

*Claim.*—"What I claim as my invention is, the preservation of fresh butter, for any length of time, as herein described, using for that purpose the aforesaid chemical compound, or its equivalent, substantially in the manner and for the purpose set forth."

8. For an *Improvement in Looms for Weaving Figured Fabrics;* Samuel and James Eccles, Kensington, Pennsylvania, August 3.

*Claim.*—"What we claim as constituting our invention is, 1st, The star movers, whether they be arranged to slide, instead of the star wheel, or otherwise, and neutral surface, in combination with the star wheel, (sliding or otherwise,) arranged substantially in the manner and for the purpose herein specified.

"2d, We claim the pins, or pattern plates, or their equivalents, in combination with the diamond shaped projection, or four sided inclined plane, lever, and star wheel, arranged substantially as described, for the purposes herein specified.

"3d, We claim the guide, in combination with the star movers and star wheel, as described.

"4th, We claim the combination formed by the mechanism herein described, for giving a positive and correct motion to the jacquard card cylinder, that is to say, the star mover, star wheel, and connecting arms, with mitre wheels, or their equivalents, as herein fully made known, and the above mechanism is also intended to be applied to other description of looms where lags and other similar devices are used, instead of the cards, as on barrel and other similar looms; therefore, the claim is not limited to the turning of a jacquard card cylinder."

9. For an *Improvement in Adjusting the Chasers in Screw Cutting Stocks;* Mitchell C. Gardner, Brockport, New York, August 3.

"The nature of my invention consists in arranging an adjustable band, on which the index is lettered, for adjusting the index to the chasers, the same being adjustable to the wear of the chasers, or to chasers of different lengths, and in combination with suitable apparatus for causing said chasers to approach or recede from a common centre."

*Claim.*—"Having thus fully described my invention, I do not claim the index, but what I do claim is, the adjustable band, *d*, fig. 4, and *d*, *d*, fig. 5, on which the index is lettered, for adjusting the index to the chasers; the same being adjustable to the wear of the chasers, or to chasers of different lengths; and in combination with suitable apparatus for causing said chasers to approach and recede from a common centre, for the purposes stated.

"And I also claim the shaft, *f*, as shown in figs. 2 and 4; and pinion, H, fig. 2, in combination with pinions, G, G, G, G, fig. 2, and the bevel gear wheel, E, fig. 3, at the outer end of which shaft is attached a crank, to drive the bevel gear wheel, E, fig. 3, as herein before set forth and described, and for the purposes stated."

10. For an *Improvement in Scales for Weighing;* William P. Goolman and William Holtsechaw, Jr., Springtown, Indiana, August 3.

"The nature of our invention consists in making the weighing beam with two long graduated arms, instead of one only, and applying a pea, or weight, to each of them; the divisions on one arm indicating pounds, or tens, or hundreds, &c., of pounds, according to the size of the balance, and those on the other arm, the ounces, quarter pounds, or pounds, or any sub-divisions or fractions of the larger weights that may be desired."

*Claim.*—"What we claim as our invention is, the making of the weighing beam of platform or other balances, or scales, with two graduated arms, extending in opposite directions from the fulcrum of said beam, and applying one or more movable weights, or peas, to each of them; the divisions on one arm indicating the larger divisions of weight, and those on the other, any sub-divisions or fractions of the larger that may be desired, substantially as herein set forth and described."

11. For an *Improvement in Jacquard Looms;* John Goulding, Worcester, Massachusetts, August 3.

*Claim.*—"What I claim as my invention is, 1st, connecting the knot and trap boards with, and operating them by levers, arranged substantially as herein described, so that the second row of heddles or harness, shall fall and rise so much farther than the first, and the third than the second, and so on through the entire series of heddles, or harness, that, as the warp is sprung, the threads in the same shed, from each row of heddles, whether front, middle, or back, and whether sprung in the top or bottom shed, all lies substantially in the same plane.

"2d, The apparatus which inserts and draws the wires to form the pile, constructed and operated substantially as described.

"3d, The devices for locking and unlocking the beam or beams containing the warp, substantially as described."

12. For an *Improvement in Ox Yokes;* Ezra Hough, St. Johnsville, New York, August 3.

"By the use of my improved slide yoke, oxen will work much easier, and will not crowd, or haul, as is often the case, in using the ordinary yoke; each ox endeavoring to obtain some advantage over his mate."

*Claim.*—"I do not claim the slides, independently of their connexion, as they have been previously used; but, having described the nature of my invention, what I claim as new is, the connecting of the slides, in which the bows are secured, by means of the chains and rods; the chains passing over the pulleys, by which neither of the slides or bows can be moved laterally, without communicating a corresponding opposite motion to the other; thus keeping the oxen, at all times, at equal distances from the centre of the yoke, the chains, rods, and pulley, being arranged as shown and described, or in any other manner substantially the same."

13. For an *Improved Elastic Horse Shoe;* John O. Jones, Newton, Massachusetts, August 3.

*Claim.*—What I claim is, the shoe, formed with two plates, between which a sheet of vulcanized rubber or other elastic substance is interposed, in the manner and for the purpose herein set forth."

14. For an *Improvement in Scythe Fastenings;* Alpheus Kimball, Fitchburgh, Massachusetts, August 3.

*Claim.*—"Now, I would remark that I do not claim the invention of confining the shank to the snath, by fastening contrivances applied both to the heel and toe of the scythe, particularly when the fastening contrivance of the toe is made to press against the toe, in a direction towards the heel of the scythe, as, under such circumstances, the variation of the angle of the blade and snath is generally limited to certain fixed positions; but what I do claim as my improvement is, to make the fastening bolt of the toe act against the side of the toe, or laterally against the shank, in combination with making it, or the bolt and shank, with the peculiar curved projection, and recess, and the flattened faced stirrup, or confining contrivance of the heel of the shank, so as to allow of the lateral position of the heel being changed, or varied, as specified, whereby the angle of the shank part of the snath and of the blade may not only be varied to any extent within certain limits, but the toe of the shank, as usually made, confined down by other means than that which operates to secure the shank (at its heel) to the snath."

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## MECHANICS, PHYSICS, AND CHEMISTRY.

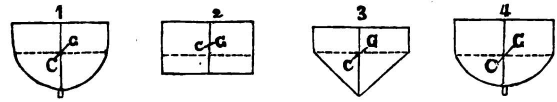
### *Hints on the Principles which should regulate the Forms of Boats and Ships; derived from original Experiments. By* Mr. William Bland, *of Sittingbourne, Kent.**

Continued from page 132.

#### Chapter XI.—Of the Lee Way, or Lateral Resistance.

This property in a ship depends (see experiment 5,) directly upon the perpendicular depth at which it floats, and the length. The following is a course of experiments relative to the lateral resistance of different midship sections or forms, and having reference to the depths of keels.

The midship forms selected for the experiments were those which had been employed in Chapter X., Experiments 41, &c. The diagrams are again given, but with the addition of keels to two of them. The results were measured by the length of lever, not by weights.




c, the centre of gravity, and the dotted lines the depth of flotation.

* From the London Architect for September, 1851.

*Experiment* 44.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight. | Each with ½-inch |
| No. 4. Elliptic bottom, | 1 lb. 13 oz. | depth of keel. |

*Result.*—No. 1 resisted most, and equal to 1 inch of lever.

*Experiment* 45.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | Each with ½-inch |
| No. 2. Flat bottom, | 1 lb. 13 oz. | depth of keel. |

*Result.*—No. 2 resisted most, and equal to 1½ inch of lever.

*Experiment* 46.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | Each with ½-inch |
| No. 3. V or Triangular bottom, | 1 lb. 13 oz. | depth of keel. |

*Result.*—No. 3 resisted most, and equal to 1 inch of lever, but was disposed to turn over.

*Experiment* 47.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | With ½-inch keel. |
| No. 4. Elliptic bottom, | 1 lb. 13 oz. | With 1 inch keel. |

*Result.*—No. 1 resisted most, and equal to 1 inch of lever.

*Experiment* 48.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | With ½-inch keel. |
| No. 2. Flat bottom, | 1 lb. 13 oz. | With 1 inch keel. |

*Result.*—No. 2 resisted most, and equal to 1½ inch of lever.

*Experiment* 49.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | With ½-inch keel. |
| No. 3. V or Triangular bottom, | 1 lb. 13 oz. | With 1 inch keel. |

*Result.*—No. 3 was overturned by the resistance.

*Experiment* 50.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | Each with ¼-inch |
| No. 2. Flat bottom, | 1 lb. 13 oz. | depth of keel. |

*Result.*—No. 2 resisted most, and equal to 3 inches of lever.

*Experiment* 51.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | Each with ¼-inch |
| No. 4. Elliptic bottom, | 1 lb. 13 oz. | depth of keel. |

*Result.*—No. 1 resisted most, and equal to 1 inch of lever.

*Experiment* 52.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | Each with ¼-inch |
| No. 3. V or Triangular bottom, | 1 lb. 13 oz. | depth of keel. |

*Result.*—No. 3 resisted, but overturned.

*Experiment* 53.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | With ½-inch keel. |
| No. 2. Flat bottom, | 1 lb. 13 oz. | With ¼-inch keel. |

*Result.*—No. 2 resisted most, and equal to 1½ inch of lever.

*Experiment* 54.

| | | |
|---|---|---|
| No. 2. Flat bottom, | Weight, | No keel. |
| No. 3. V or Triangular bottom, | 1 lb. 13 oz. | No keel. |

*Result.*—The resistance equal.

*Experiment* 55.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | No keel. |
| No. 3. V or Triangular bottom, | 1 lb. 13 oz. | No keel. |

*Result.*—No. 3 resisted most, and equal to 4 inches of lever.

*Experiment* 56.

| | | |
|---|---|---|
| No. 3. V or Triangular bottom, | Weight, | No keel. |
| No. 4. Elliptic bottom, | 1 lb. 13 oz. | No keel. |

*Result.*—No. 3 resisted most, and equal to 6 inches of lever.

*Experiment* 57.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | With ½-inch keel. |
| No. 2. Flat bottom, | 1 lb. 13 oz. | No keel. |

*Result.*—No. 2 resisted most, and equal to 1½ inch of lever.

*Experiment* 58.

| | | |
|---|---|---|
| No. 1. Semicircular bottom, | Weight, | With 1 inch keel. |
| No. 4. Elliptic bottom, | 1 lb. 13 oz. | With ½-inch keel. |

*Result.*—The resistance was equal, but No. 1 overturned.

*Observations on the Results of the Lateral Resistance of the Four Models.*

No. 1 resisted most with a depth of keel of ½-inch.

No. 2 resisted most with a depth of keel of ¼-inch, ½-inch, 1 inch, and no keel.

No. 3 resisted most with no keel.

No. 4 was beat in every instance when tested against either of the others with equal depth of keel; but was equal to No. 1 when that had 1 inch keel and No. 4 had ½-inch keel.

Again, No. 1 possessed the least resistance with 1 inch of keel.

No. 2. The variations in the depth of keel made no difference.

No. 3 had the least resistance with 1 inch of keel.

No. 4 had the least resistance with no keel.

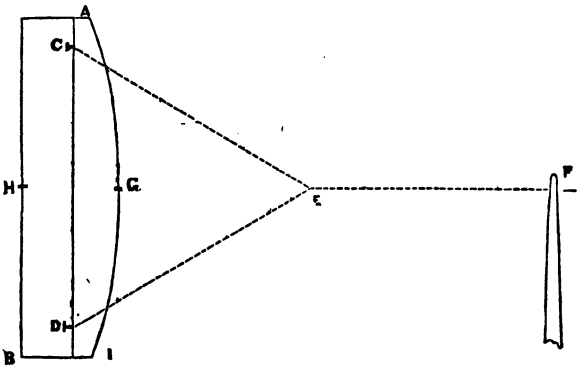
The scale of superiority appears to be thus—

No. 2, the flat bottomed, most decidedly the best, or . . . 1.
No. 1, the semicircular bottomed, . . . . . . . . 2.
No. 4, the elliptic-bottomed, . . . . . . . . . 3.
No. 3, the triangular bottomed the most dangerous, except with no keel, . . . . . . . . . 4.

On turning to the diagrams it will be seen that the centres of gravity of Nos. 2 and 4 are lower than those of Nos. 1 and 3. Again, the lines of flotation of Nos. 2 and 4 are likewise lower than Nos. 1 and 3. This being the case, the lateral leverage of Nos. 2 and 4 above the water is greater than that of the other two; and their leverage is, on the contrary, greatest in the water, particularly the triangular bottom. No. 2 floats higher than it would have done, had it not been made hollow in part to reduce its weight down to the others.

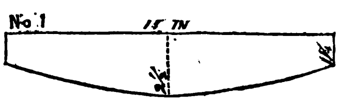
The mode by which the lateral resistance was tested will be clearest understood by the inspection of the accompanying diagram. A B represents the upper surface of the models, being 14 inches long and 4 inches wide at G H; C, and D, the two rails to which the lines, C E,

and D E, were attached; E F, is the single line fixed on the end of the balance rod, F. The sides of the models were rounded off as A G I, to prevent oscillation whilst being drawn through the water; at the same time, partaking more of the usual form of the sides of a ship.

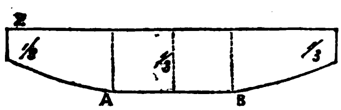



Whilst carrying out these experiments on lateral resistance and keels, many instances occurred of the superior effects in the lengthening of a keel, over the deepening of one. The deepening of a keel acts directly and powerfully to overturn—not so the lengthening; and although a small addition in depth may and does, under certain circumstances, improve a ship's lateral resistance, yet, if the depth be much increased, it so militates against the object sought by the great inclination which ensues, consequent on the force of lateral resistance, as to be altogether injurious.

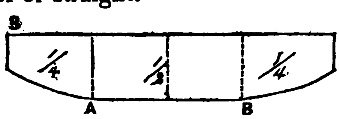
The next experiments were taken to ascertain the effects, as regards speed, of curving up the bottoms of vessels from the midship or mid length, to both head and stern as high as the load water line; or commencing the same at one-third or one-fourth of the length of each, and leaving the middle one-third or one-fourth of each quite straight or uncurved.




*Experiment* 59.—A model, 14 inches long, 4 inches wide, and $2\frac{1}{2}$ inches in thickness, weight, 30 oz.; curved from middle length to head and stern, as No. 1.




*Experiment* 60.—The model, No. 2, of the precise length, breadth, depth, and weight, as No. 1, but having the bottom, A B, one-third of the length, quite level or straight.



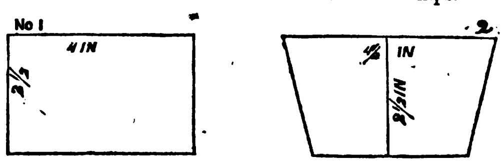

*Experiment* 61.—The model, No. 3, of the same dimensions, &c., as the preceding, but with the bottom, A B, left flat half of the length.

*Result.*—No. 1 beat in speed No. 2, by $1\frac{1}{4}$ oz. extra weight; No. 2 beat in speed No. 3 by 2 oz. extra weight; therefore, No. 1 beat in speed No. 3, by $3\frac{1}{4}$ oz. extra weight.

*Experiment* 62.—This experiment was undertaken to ascertain what might be the advantage, as regards stability, by constructing a ship with projecting sides, instead of carrying them up perpendicularly.

Two models were made, each 15 inches long, $2\frac{1}{2}$ inches deep, with flat bottoms; but one of them 4 inches wide, and perpendicular sides, the other being in width at the bottom at midships $3\frac{1}{2}$ inches, and across the top $4\frac{1}{2}$ inches, and making an angle from the perpendicular of 11°.

Sections of the Models taken at the midships.




Scale, $\frac{1}{2}$-inch to 1 inch; weight of each, 40 oz.

These models were first tested upon the water, each in solid wood, when the stability of each equalled 3 oz. But when a part of the upper insides of both the models was hollowed out, which reduced their respective weights to 33 oz., the stability of No. 1 equalled $3\frac{1}{2}$ oz., and that of No. 2, 3 oz. only.

Let it be observed, that before either of the models were lightened, No. 1 sank in the water $1\frac{1}{4}$ inch, and No. 2, $1\frac{3}{8}$ inch. After being lightened, No. 1 sank in the water $1\frac{1}{8}$ inch, and No. 2, $1\frac{1}{4}$ inch.

The result of lightening the weight of each model from the upper part was the lowering of their centres of gravity, which at once became apparent in No. 1, by its increased stability. But the same result did not follow in No. 2, because of the diminished width of the lower line of its flotation. This proves, most clearly, that the mere lowering of the centre of gravity acts with far less effect, with respect to the increase of stability, than the widening of the beam, or preserving the same as in No. 1.

## Of the Rudder.

The rudder is a flat frame-work of timber, ascending perpendicularly from the bottom of the keel, to a distance above the surface of the water, sufficient to admit of a lever being fastened to it in nearly a horizontal position, to move the same either to the right or left; it being so attached to the stern post by means of hooks and rides, or similar contrivances, as to admit of such lateral motion.

The purpose of the rudder is to alter the direct course of a vessel, when its body is going through the water, and into any position the helmsman may desire. That the rudder may act with full effect, it is necessary for the water to have as direct and unimpeded a course against either of its sides, as it is possible to allow. The wider the body of the rudder is made, the greater the power; but in general, it does not much exceed in sailing vessels one twenty-eighth part of a ship's length.

### Of the Keel.

The keel is that part of a boat or ship, which is situated at the bottom on the outside, and extends in a direct line from the cut-water at the head, to the post at the stern, descending perpendicularly down below the hull to the depth of several inches or feet according to the size of the vessel. Its uses are, first, to cause the floating body, say of a ship, to preserve a direct course in its passage through the water; second, to act as a check to lee-way; third, to moderate the rolling motion.

Ships formed with flat bottoms, and particularly if they be constructed with parallel sides, require little depth of keel to preserve a direct course; and in order to check the lee-way, a substitute for a keel is applied in the form of a sliding keel, suspended over the lee side, as seen in barges. But when the bottoms of vessels are not flat, or do not draw the same depth of water at the head and stern, particularly the latter, the keel becomes more essential, or the ship will have a rotary motion and be under no command.

With regard to the depths of keels, it will be needless to repeat what has already been given in the experiments, from 48 to 58, Chapter XI.

(To be Continued.)

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Translated for the Journal of the Franklin Institute.

## *New Method of Magnetizing Steel.* Letter of Mr. Hamann.

While studying the construction of electro-magnetic apparatus, I looked for the means of making very energetic magnets. I have discovered a new method of magnetizing steel dry-tempered, which is in some degree the opposite of the ordinary method. I magnetize first and temper afterwards. I cause a magnet or an electric current to act on the steel heated to redness, and I temper it while in this condition. The experiment is very simple; by taking a small bar of steel of 3 millimetres square by 6 centimetres long, (0·1 in. by 2⅜ inches,) heated to redness with the pole or between the poles of a magnet, to which at a certain temperature it will remain attached, and plunging the whole into water. In this way will be obtained a small magnet of considerable energy. English refined cast steel, which tempers at a relatively low heat, appeared to me the most suitable for these experiments. I operated with advantage, as compared with other modes of magnetizing, upon bars 12 millimetres (0·4 in.) broad, 6 mm. (0·2 in.) thick, and 17 centimetres (6·7 in.) long. I propose to follow up my experiments, and I believe that the simple fact of the magnetizing of steel before tempering it, is of a nature to interest those who occupy themselves in this branch of physical science.—*Comptes Rendus de l'Academie des Sciences, (Paris,) 29th March,* 1852.

Note.—In *Silliman's Journal* for 1839, Vol. xxxvi. p. 335, will be found an interesting account by J. Lawrence Smith, of his experiments with the above process of magnetizing steel bars, in which he carried it further into successful practice than Mr. Hamann seems to have done. Something resembling it must be also the method of Mr. Faber, by which the magnets of his steam gauge are enabled to resist temperatures, at which the force of bars treated in the usual way, is altogether lost. It would be very desirable to have a detailed description of Mr. F.'s processes and experiments.

For the Journal of the Franklin Institute.

## *On the Telegraphic Lines of the World.* *By* Dr. L. Turnbull.

Continued from page 138.

### United States.

Before concluding my list of the lines in the United States, I received the following interesting account of the telegraph in Ohio, showing the rapid progress which it is making in the West, for which account I am indebted to the politeness of J. H. Wade, Esq., of the "Wade Telegraph Office," Columbus, Ohio.

| | Miles. |
|---|---|
| Cleveland and Cincinnati Telegraph Company, with two lines on separate routes, with an arm from Newark to Zanesville, and another from Mansfield to Sandusky; length of line, . . . . . . | 640 |
| Cincinnati and Sandusky Telegraph Company, line from Cincinnati to Sandusky, | 218 |
| Scioto Valley Telegraph Company, line from Columbus to Portsmouth, | 90 |
| Columbus and Lancaster Telegraph Company, line from Columbus to Lancaster, 25 miles, and an arm to Logansport, 15 miles, . . . . | 40 |
| Pittsburg, Cincinnati, and Louisville Telegraph Company, from Pittsburg to Louisville, two wires on same poles, 280 each, (in Ohio,) . | 560 |
| Cincinnati and St. Louis Telegraph Company, from Cincinnati to St. Louis, | 50 |
| House Printing Telegraph line, from Buffalo to Cincinnati, . . | 325 |
| Erie and Michigan Telegraph Company, from Buffalo to Milwaukie, with two wires as far as Cleveland; length of wire in Ohio, . . . . | 260 |
| Lake Erie Telegraph Company, from Buffalo to Detroit, with branch to Pittsburg; length of wire in Ohio, . . . . . . . . | 286 |
| Cleveland, Wheeling, and Zanesville Telegraph Company, . . | 225 |
| Cleveland and Pittsburg Telegraph Company; length of wire in Ohio, . | 90 |
| New Orleans and Ohio Telegraph Company, from Pittsburg to New Orleans; length of wire in Ohio, . . . . . . . . . . . | 260 |
| Ohio, Indiana, and Illinois Telegraph Company, from Cincinnati to Dayton and Chicago; length in Ohio, about . . . . . . . | 100 |
| Line from Zanesville to Marietta, . . . . . . . . . | 66 |
| Total length of wire in Ohio, . | 3210 |

### Canada.

From O. S. Wood, Esq., Montreal Telegraph Company, I have received the list of the lines in Canada.

| | Miles. |
|---|---|
| The Montreal Telegraph Company's Line extends from Quebec to the Suspension Bridge at Niagara Falls; distance, . . . . . | 155 |
| British North American Electric Telegraph Association, from Quebec to New Brunswick frontier; distance, . . . . . . | 220 |
| The Montreal and Troy Telegraph Company, from Montreal to New York State line at Highgate; distance, . . . . . . . | 47 |
| The Bytown and Montreal Telegraph Company, from Bytown to Montreal; distance, . . . . . . . . . | 115 |
| The Western Telegraph Company, from Hamilton to Port Sarnia, at the foot of Lake Huron; not now working; distance, . . . . | 143 |
| Niagara and Chippewa Line, from Niagara to Chippewa; distance, . | 14 |
| All the above lines have single wires. | |
| In course of construction, a line from Brantford to Simcoe and Dover; distance, | 33 |
| Also, a line from Kingston to Hamilton, via. Prince Edwards Co.; distance, | 256 |
| Total length in Canada, . . . | 983 |

### England.

The English telegraphs come next in extent to those of the U. States; they were first established in 1845, and may be divided into two classes, the railway and the commercial. The railway telegraphs are used for the purpose of sending communications relative to railway matters, while the commercial are employed for the transmission of public and private messages at fixed rates of charges. They are mostly built on the railroads, and in some instances a railroad company will construct a line, and give the use of it to a company, and as an equivalent, the telegraph lends its aid to expedite the business of the railroad. The telegraph company between London and Liverpool receives one thousand pounds a year for doing the business of the railroad company, and the railroad people afford them all the facilities for repairing the line, even so far as sending an extra engine, without charge, when there is not a regular train going out soon; and every man employed on the railroad is under instructions to report immediately to the nearest telegraph office, anything he may find to be out of order on the line. In fact, a line of telegraph is almost considered an indispensable part of the equipage of all well regulated roads in England. The instruments principally in use are those of Messrs. Cook and Wheatsone, Jacob Brett, and Brett and Little. There is a line of Bain's Electro-Chemical Telegraph from London to Manchester, and from Manchester to Liverpool. Also, a line of Bain's Electric Telegraph, connecting Edinburgh and Glasgow, a distance of 46 miles: the whole extent of telegraphic lines is estimated at 2225 miles. The principal ones are as follows:

### England, Scotland, and Ireland.

I extract from the Manual of Mr. Walker, telegraphic engineer, a list of the linesof the Electric Telegraphs of England, for 1852.

| | Miles. | Wires. | Apparatus. |
|---|---|---|---|
| Edinburgh and Glasgow, | 47½ | 5 | 8 |
| Line of the Tunnel, | 1 | 2 | 2 |
| Edinburgh and the North Branch to Dundee, | 26 | 3 | 6 |
| " " " Perth, | 6 | 3 | 0 |
| Edinburgh and Granton, | 3 | 3 | 3 |
| Line to Leith, | 1½ | 3 | 3 |
| Line of Tunnel, | 1 | 2 | 2 |
| North British, | 58 | 5 | 8 |
| Branch to Dalkeith, | 1¼ | 2 | 2 |
| " Haddington, | 5 | 2 | 2 |
| Line of the Tunnel, | 1¾ | 2 | 2 |
| York, New Castle, and Berwick. | | | |
| New Castle to Berwick, | 65½ | 5 | 7 |
| York to Darlington, | 45 | 7 | 15 |
| Darlington to New Castle, | 38½ | 8 | 14 |
| Branch to Shields, | 11 | 3 | 2 |
| " Sunderland, | 2¼ | 3 | 2 |
| " Durham, | 2¼ | 2 | 1 |
| " Richmond, | 9 | 2 | 1 |
| Fatfield and South Shields, | 19 | 1 | 4 |
| Branch to Stockton, | ½ | 1 | 2 |
| Carried up, | 345 | 64 | 86 |

| | Miles. | Wires. | Apparatus. |
|---|---|---|---|
| Brought up, | 345 | 64 | 86 |
| York and North Midland. | | | |
| Normanton to York, | 24½ | 0 | 5 |
| York to Scarborough, | 42½ | 3 | 5 |
| Branch to Harrowgate, | 18 | 3 | 2 |
| Hull and Selby, | 36 | 5 | 5 |
| Hull and Bridlington, | 33 | 3 | 4 |
| Normanton to the junction at Milford, | 10 | 2 | 2 |
| Manchester and Leeds, | 51 | 7 | 24 |
| Preston and Wyre, | 20 | 3 | 4 |
| Liverpool and Southport, | 13¼ | 3 | 3 |
| East Lancashire, | 12½ | 3 | 0 |
| Midland Railway. | | | |
| Birmingham and Gloucester, | 53 | 7 | 9 |
| " " Derby, | 6½ | 7 | 6 |
| " " Derby, | 34¾ | 5 | 0 |
| Derby and Lincoln, | 48¾ | 3 | 4 |
| " Rugby, | 24¼ | 7 | 7 |
| " Rugby, | 24¾ | 5 | 0 |
| Leicester and Peterborough, | 4¾ | 3 | 0 |
| " Peterborough, | 23 | 5 | 11 |
| " Peterborough, | 25¼ | 7 | 0 |
| Derby and Leeds, | 73 | 7 | 25 |
| Branch to Sheffield, | 5 | 3 | 2 |
| Leeds and Bradford, | 11 | 6 | 5 |
| " Bradford, | 2¾ | 3 | 0 |
| " Bradford line of Tunnel, | 1½ | 2 | 2 |
| Branch to Skipton, | 15¼ | 3 | 5 |
| London and North Western. | | | |
| London to Birmingham, | 5 | 9 | 0 |
| " Birmingham, | 107½ | 7 | 10 |
| " Birmingham line of Tunnel, | 1 | 3 | 2 |
| " Birmingham Inclined Plane, | 1¼ | 6 | 6 |
| East Junction to London, | ½ | 2 | 4 |
| Birmingham and Manchester, | 80 | 7 | 7 |
| Do. do. do. | 5 | 8 | 0 |
| Junction to Ardwick, | 3¼ | 8 | 0 |
| Manchester and Liverpool, | 31½ | 6 | 5 |
| Do. do. line of Tunnel, | 1½ | 2 | 3 |
| South Devon. | | | |
| Branch to Torquay, | 4 | 3 | 2 |
| Newmarket Railway, | 17 | 5 | 4 |
| Eastern Union, | 16¾ | 5 | 7 |
| Line of the Tunnel, | 2¾ | 2 | 3 |
| London to Southampton, | 74 | 4 | 4 |
| Do. do. | 6 | 6 | 2 |
| Branch to Portsmouth, | 21 | 4 | 4 |
| " Gosport, | 5 | 4 | 1 |
| Southampton and Dorchester, | 61 | 3 | 7 |
| Branch to Poole, | 2 | 3 | 2 |
| Eastern Counties. | | | |
| London to Brandon, | 88¼ | 7 | 40 |
| " Stratford, | 33¾ | 2 | 4 |
| Line to Brick Lane, | ½ | 2 | 3 |
| Branch to Enfield, | 3¼ | 2 | 2 |
| " Hertford, | 7 | 3 | 3 |
| Cambridge and St. Ives, | 14¾ | 3 | 5 |
| Ely and Peterborough, | 30 | 5 | 7 |
| March and Wisbeach, | 9 | 3 | 2 |
| London and Colchester, | 51¼ | 5 | 13 |
| Carried over, | 1641¼ | 298 | 368 |

| | Miles. | Wires. | Apparatus. |
|---|---|---|---|
| Brought over, | 1641¼ | 298 | 368 |
| Forestgate and Stratford, | 1¼ | 1 | 2 |
| Maldon and Braintree, | 12 | 3 | 3 |
| Stratford and Junction of the Thames, | 2¾ | 3 | 2 |
| North Woolwich, | 2¾ | 3 | 2 |
| Norfolk Railway. | | | |
| Brandon to Norwich, | 37¾ | 7 | 19 |
| Do. do. | 10¼ | 1 | 7 |
| Norwich and Yarmouth, | 20 | 9 | 0 |
| Branch to Lowestoft, | 12 | 5 | 0 |
| " Dereham, | 12 | 3 | 2 |
| Dereham and Fakenham, | 12¼ | 2 | 2 |
| North Staffordshire. | | | |
| Stoke to Norton Bridge, | 10¾ | 3 | 3 |
| Branch to Colwich, | 18¾ | 2 | 2 |
| Stoke to Burton, | 29½ | 3 | 5 |
| " " depot, | ⅔ | 2 | 2 |
| North Staffordshire. | | | |
| Stoke to Crewe, | 14½ | 3 | 4 |
| Harecastle Line of the Tunnel, | 1 | 2 | 2 |
| Branch to Macclesfield, | 19½ | 3 | 4 |
| Valley of Churnet, | 27 | 2 | 0 |
| South Staffordshire, | 9¼ | 2 | 3 |
| Do. do, | 2 | 3 | 1 |
| Northampton and Peterborough, | 47 | 3 | 10 |
| Northampton prolongated to Wolverton, | 10½ | 4 | 2 |
| London and Croydon, | 8 | 3 | 4 |
| Great Western, | 19 | 4 | 2 |
| Line of the Streets of London, | variable, | | 10 |
| Manchester and Sheffield, | 2 | 3 | 3 |
| Manchester Line of the Tunnel of Woodhead, | 3¼ | 3 | 2 |
| Ambergate, Matlock, and Buxton, | 11½ | 2 | 3 |
| London and Blackwall, | 3½ | 0 | 0 |
| Line of Caldon Low Quarry, | 3¼ | 1 | 4 |
| Mines of the coal of Moira, | ½ | 2 | 2 |
| Maryport and Whitehaven | ⅓ | 4 | 4 |
| Line of the Company of Iron Mines of Butterley, | 2½ | 1 | 2 |
| South Eastern. | | | |
| London to Dover, | 88 | 0 | 29 |
| " Rochester, | 31 | 4 | 18 |
| " Bricklayer's Arms, | 4 | 2 | 2 |
| Tunbridge to Tunbridge Wells, | 5 | 3 | 6 |
| " Hastings Road, | 1 | 2 | 2 |
| " Laboratory, | 0 | 1 | 2 |
| Paddock Wood to Maidstone, | 10 | 3 | 5 |
| Ashford to Ramsgate, | 30 | 3 | 5 |
| Minster to Deal, | 9 | 3 | 6 |
| Ramsgate to Margate, | 4 | 3 | 2 |
| Total, | 2190⅔ | 420 | 558 |

Their mode of construction in England is very expensive, amounting in some cases to $600 per mile. Posts of fir are ranged at convenient distances along the side of the principal railways; each post is furnished with an insulator of earthenware, and also capped with a wooden roof having dripping eaves to throw the water from the wires. The latter are made of galvanized iron, two of which are needed on a line working with Cook and Wheatstone's instruments.

The press of England use the telegraph but little, and pay heavily for what they get by it. The *London Times* pays one thousand pounds

per annum for a certain amount daily, and in addition, they pay for all extra communications of importance. The charge for transmission of communications by the Electric Telegraph Company's telegraphs in England, is at the rate of one penny per mile for the first fifty miles, and one farthing per mile for any distance beyond one hundred miles. The South Eastern Railway Company's charges for telegraphic communications are even much higher than those of the former. Thus, twenty words transmitted eighty-eight miles is charged the large sum of $2·42. These facts show that telegraph companies, as well as the public at large, would derive much greater advantages from their construction on a more economical plan, like that of the American system. In many parts of the United States where railways do not exist, the wires are stretched across the prairies without any protection whatever, except the general good will of the people at large. The cheap construction of these lines renders them liable to frequent disorder, and consequently needing continual repair, so that perhaps it might have been more economical to have expended more in the commencement. Its advantages are, however, abundantly proved, as the poorest person in the U. States or Canada, is enabled by the low rate of charges to use any of the telegraphs for domestic purposes. A message of twenty words can be sent a distance of 500 miles in the United States for $1, while in England the same would cost from $7 to $8.

*Sub-Marine Telegraph*, 1852.—A London letter under date of June 4th, says: The chief event of the week has been the laying down of the submarine telegraph between the coasts of England and Ireland, a distance of 64 miles. On the 2d instant, at 4 o'clock in the morning, the operation commenced by the departure of a steamer from Holyhead, and at half past eight in the evening a gun was fired at Dublin by means of the electric wire. The process has been an inexpensive one, and will probably prove remunerative, and lead to the establishment of many other lines. Among these, one of the first will be from the port of Harwich, on the east coast of England, to Holland, a concession for that purpose having lately been granted by the Dutch Government.

A similar communication with Belgium, between Dover and Ostend, is also contemplated. These enterprises will all be carried out by separate interests. The company that first established the practicability of such a method of ocean communication, by laying down the wire between England and France, might have secured all the advantages of the extension of the principle, but their Board of Directors have been incessantly quarrelling among themselves, and have consequently brought their own shares to a discount. In June, 1852, the telegraph between Dover and Ostend was completed; it is seventy English miles long.

*Telegraph Extensions*, *June* 27.—Private letters received per Atlantic state that F. N. Gisborne, Esq., the agent of the Newfoundland Electric Telegraph Company, has contracted in England for the land wire, through Newfoundland, upon very favorable terms. Mr. Gisborne has also entered into contracts for the sub-marine line, connecting Newfoundland with Nova Scotia, upon terms much less than estimated. Messrs. Newall & Co. of London, the contractors for the submarine, have also entered into contract to lay down a line from the Hague to Harwich, a distance

of 135 miles, and are now negotiating with the French Government for a line from France to Algiers; a stretch of 400.

### Ireland.

An Irish Sub-marine Line Telegraph, between Fort Patrick and Donoughadee, was to be opened on the 10th of June.

A line of telegraph has been opened between Dublin and Galway, and was in operation in June, 1852.

### Prussia.

The Prussian Telegraph system is characterized as simple, substantial, effective and economical. A Royal Commission was appointed in 1844, to ascertain the best method of constructing lines; they, after experiment, determined on that of copper wire enclosed in gutta percha, and buried two feet beneath the surface; they are generally made to follow the track of railways, and in passing over bridges or aqueducts, are enclosed in iron piping, or when through rivers in chain pipes. They use but one wire, which terminates in an earth battery, consisting of a zinc plate 6 feet long, 2½ feet wide, and ⅛-th of an inch in thickness. The instruments used are those of Morse, Siemens, Halske, and Kramer, together with Daniel's battery. In the principal offices, a printing and a colloquial instrument are employed, but each in turn is worked by the one wire only, notice being given that one or the other is to be used, according to circumstances. Morse's is the printing telegraph used, and differs but very little from that used in the U. States. Those of Siemens and Kramer are both colloquial telegraphs, but Siemens' is chiefly used. The whole cost, as determined from detailed estimates, is less than $200 per English mile. Besides the government lines of telegraph, most of the railway companies in Prussia, have also their own telegraphs, which are constructed according to the system in this country by one wire suspended on poles along the railways. The average cost of this form of telegraph is about $100 per mile; their whole length is estimated at 1493 miles, having their central point at Berlin, from whence they radiate as follows:

| Instruments used. | Stations and points passed through. | Distance in miles. |
|---|---|---|
| Siemens and Halske's Patent, | From Berlin to Frankfort on the Main, established in February, 1849, . . . . . . . | 350 |
| Kramer's Bell Telegraph, | From Berlin through Cologne to Achen, established in June, 1849, . . . . . . . | 362 |
| | Stations are Potsdam, Magdeburgh, Ochsertleben, Brunswick, Hanover, Minder, Haurm, Dusseldorf, Deutz, Cologne. | |
| Seimens and Halske's Patent, | From Dusseldorf to Elberfeld, . . . . . | 16 |
| Morse's Apparatus, | From Berlin through Minder to Rolu, . . . | 81 |
| Siemens and Halske's, | " " to Hamburgh, . . . . . | 142 |
| " " | " " Stettin, . . . . . . . | 62 |
| " " | " " through to Oderburgh to Breslau, . | 280 |
| " " | " Halle to Leipzic, . . . . . . . | 17 |
| " " | " Leipzic to Berlin, . . . . . . . | 115 |
| " " | " Leipzic to Frankfort on the Main, . . | 204 |
| Siemens' Telegraph, | " Berlin to Gross Bercen | |
| " " | A contemplated one from Berlin to Konigsberg to Dantzic. | |
| Morse Instrument, | From Hamburgh to Cuxhaven, . . . . . | 80 |

The Prussian method of burying the wires beneath the surface, protects

them from destruction by malice, and makes them less liable to injury by lightning.

## Austria.

The Austrian Telegraphs diverge from Vienna, in the following manner:

1, From Vienna through Olmutz to Prague, 237 miles.
2, " " " Bumn " 211 "
3, " " to Pressburgh, 35 "
4, " " through Prevau to Oberberg, 140 "
5, " " " Bruck, Cilli, Layback to Trinte, 284 "
6, " " " Lintz to Saltzburg, 156 "
7, " Prague to the boundary of Saxony, to connect with the line from Dresden, is nearly complete as far as the boundary of Bohemia, on which Storer's apparatus will be used; on the other a modification of Morse's by Robinson, printing about 600 words per hour; also, a modification of Bain's needle telegraph, by Ekling, of Vienna, containing an arrangement of 45 needles, averaging about 190 words of six letters each per hour. The Austrians have adopted this system of correspondence, mostly since 1847; their network of telegraphs extends over a space of more than 1053 miles, having 106 stations, which will be increased to 200 stations, if the present projected lines are constructed. The line from Lintz to Saltzberg, has a connexion with the Bavarian one from Munich to the latter place, and makes use of Stochriss' instrument. A line between Venice and Milan with its branches is already commenced.

## Saxony and Bavaria.

Saxony and Bavaria have government lines which connect with the Prussian and Austrian lines, and establish a communication with Berlin, Dresden, Munich, and Vienna. Nearly all the railroad companies have private lines for their own use, and preparations are now making, which in no distant future will include every town of importance throughout Germany in this network of communication.

Those of Saxony extend over 265 miles, the principal of which are annexed: From Leipzig to Hoff, 94 miles; from Leipzig to Dresden, 62 miles; Dresden to Konigstien, 15 miles; Dresden to the boundary of Bohemia; Dresden to Hoff, 94 miles. Stochriss' needle instrument is principally used in this country; likewise, in Bavaria his bell apparatus. The extent of lines in the latter country is about 455 miles. From Munich to Salzburg, 74 miles, connecting with the Austrian lines of Ling and Vienna; from Munich through Augsburgh to Hoff, 226 miles, connecting with the line to Dresden in Saxony; from Munich to Augsburg, 31 miles; one under construction from Augsburg, through Nuremburgh and Bamburgh to Hoff; from Bamburgh to Wurzburg, Aschappenburg, and Frankfort, 125 miles under construction.

## Tuscany.

The lines in Tuscany number 120 Italian miles, commenced in 1847, under the direction of Matteucci; they also follow the railroad. From Florence to Livourne; from Empoli to Sienne; from Pisa to Lucca, and from Florence to Patro; which makes in all, 120 Italian miles, or nearly

60 leagues. The total length of the wires is 121 leagues, weghing 70,000 pounds; 2488 posts.

The expense of placing the wire which cost at first 400 pounds per mile, is reduced to 30 or 40 francs at present, that the wires are placed by the guardians of the telegraph. The telegraphic apparatus is furnished in part by M. Brequet, and part by the constructor of the University, M. Pierncci; a complete apparatus costs 600 livres.

The following is a table of necessary expense for the establishment of the Tuscan lines:—

| | Livres. | Sous. | |
|---|---|---|---|
| Iron Wire, | 23,348 | 8 | |
| Posts of fir tree, | 21,426 | 13 | 4 |
| Tenders, | 3,347 | | |
| Porcelain shield, | 2,627 | 13 | |
| Wooden box, | 1,772 | 13 | 4 |
| Furniture, and supplies of the office, | 8,183 | 18 | 8 |
| Laying of copper wire, varnish, | 5,314 | 13 | 4 |
| Machines and piles, | 26,043 | 17 | |
| Timber, cost of posts, administration, studies, and superintendance of the work, | 3,443 | 3 | 4 |
| Total, | 95,507 | 10 | |

GERMANY.

The telegraph lines of Germany have chiefly been established within the last three years. Gauss and Weber at Gottingen, and Steinhiel at Munich, had short lines of telegraph, in 1834 and 1837; but the railroad companies were the first to make a proper appreciation of them, and establish lines for their own benefit. The first great line along the railway from Mentz to Frankfort, was erected by Fardly, a mechanician of Manheim, with Wheatstone's index apparatus. It was this line that aroused the attention of the Prussian Government, and caused the appointment of a committee to experiment on the matter.

No. 781 of the London *Mining Journal* for 1850, states that 2000 miles of telegraph are already open in Germany, and that 1000 more will be added in 1851; it works now from Cracow to Trieste, a distance of 700 miles, and a general union of the Austrian, Prussian, Saxon, and Bavarian lines was soon expected, with a tariff of charges nearly as low as that of the United States.

(To be Continued.)

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## *Explanation of Diagrams Illustrating the Action of the Forces on the Crank of a Steam Engine.* By W. POLE, C. E.*

(*With a Plate.*)

[In the year 1849, the Society of Arts offered a prize "for the best collection of diagrams (with explanations,) to illustrate the action of the forces on a crank or cranks turned from a horizontal direct action steam cylinder or cylinders; the effect of various proportions of connecting rods, and degrees of expansion of steam, being shown."

The present paper was communicated to the Society in accordance with their invitation, and obtained the silver Isis medal. It is now first printed by the joint permission of the Society and the author.]

The 15 diagrams contained in plate II, illustrate the action of the forces

* From the London Journal of Arts and Sciences, April, 1852.

on one and two cranks, turned from horizontal direct action steam cylinders; the effect of various proportions of connecting rods, and degrees of expansion of steam, being shown.

The varieties of expansion taken in these diagrams, are three, viz:

Steam admitted during the whole stroke, (Nos. 4, 5, 6.)
" " half the stroke, (Nos. 7, 8, 9.)
" " one-fourth the stroke, (Nos. 10, 11, 12.)

It has not been thought necessary to exhibit a higher degree of expansion than four times; this limit being seldom exceeded in crank engines.

The varieties of length of connecting rod have also been taken at three, viz:

Connecting rod indefinitely long, (supposed to act always in parallel directions.) (Nos. 1, 4, 7, 10.)
Connecting rod five times the length of crank, which may represent about the ordinary length. (Nos. 2, 5, 8, 11.)
Connecting rod three times the length of crank, or about the shortest made. (Nos. 3, 6, 9, 12.)

Diagrams Nos. 1, 2, and 3, are explanatory of the action of the forces, in the transmission of the power from the piston to the crank, for the three varieties in the length of connecting rod respectively. AB is the piston rod, supposed to be propelled forward by a certain pressure of steam, in the direction shown by the arrow. At the joint, B, this pressure resolves into two; one in the direction, BG, (causing the friction on the guide;) the other along the connecting rod, BC; the latter force being = the pressure on piston $\times$ secant of angle, CBD. At the crank pin, C, the force acting along the connecting rod, is again resolved into two; one along the crank, CD; the other, the *tangential force*, tending to turn the crank round in the direction, CT. This tangential force is = the force acting along connecting rod $\times$ sine of angle BCD.

The object of diagrams Nos. 4 to 12, is to exhibit the values and variations of the first and last named forces; or, so to speak, the forces at the beginning and end of the engine; *i. e.*, the pressure of steam on the piston, and the force turning the crank round.

Each of these diagrams contains two figures. The left hand figure shows the pressure on the piston at all points of the stroke, on the plan of rectangular co-ordinates; the abscissa representing the space passed over by the piston, and the ordinate the corresponding pressure. Thus, when the piston has moved from 0 to $x$, No. 8, or $\frac{7}{10}$ths of the whole stroke, the steam pressure upon it is represented by the line, $xy$. The scale given under the left hand figure, in Nos. 4, 5, 6, and which also applies to Nos. 7 to 12, shows the position of the crank corresponding to any given position of the piston; thus, in No. 6, it is seen, by inspection, that when the piston has passed through $\frac{5}{10}$ths of its course, the crank has passed through about 81° from the dead point; and so on.

The right hand figure in each diagram represents the tangential or working force, acting on the crank pin, at every point of its semi-revolution from E to F, Nos. 1, 2, and 3. The curve of this figure is also laid down by rectangular co-ordinates: the path of the crank pin (reduced to a straight line,) forms the line of the abscissæ, while the ordinates express the corresponding forces. Thus, in fig. 5, when the crank pin has moved

from 0 to $\theta$, or 120° from the dead point, the tangential force tending to turn it round, is represented by the line $\theta p$.

The additional scale, under this figure, shows the position of the piston corresponding to any given position of the crank; thus, in fig. 5, when the crank is at 140°, the piston has moved through $\frac{9}{10}$ths of its stroke, and so on.

The lines representing the forces are measured by a scale, which is appended to fig. 4. The pressure of the steam upon the piston, while the steam valve is open, is made = 100 on the scale; and the ratio of any other force to this pressure is therefore easily ascertained by simple measurement.

Diagrams 4, 5, and 6, show the values of the forces when the steam is admitted during the whole stroke.

In No. 4, the connecting rod is supposed indefinitely long; the pressure on the piston is uniform at 100. The tangential force on the crank pin begins at 0 when the crank is at the dead point; increases to 100 when it arrives at 90°; and diminishes again to 0, in the same ratio as the increase. The mean value of the force, throughout the semi-revolution, is = 63·6, which, × the space passed through by the crank pin, is exactly = the pressure on the piston × the length of its stroke; or, in other words, the area of the figure *efg* = the parallelogram *abcd*. This result is in accordance with the principle of "conservation of *vis viva*," by which we know that, (neglecting friction,) the amount of power or work given out at the crank pin is equal to that performed by the steam on the piston.

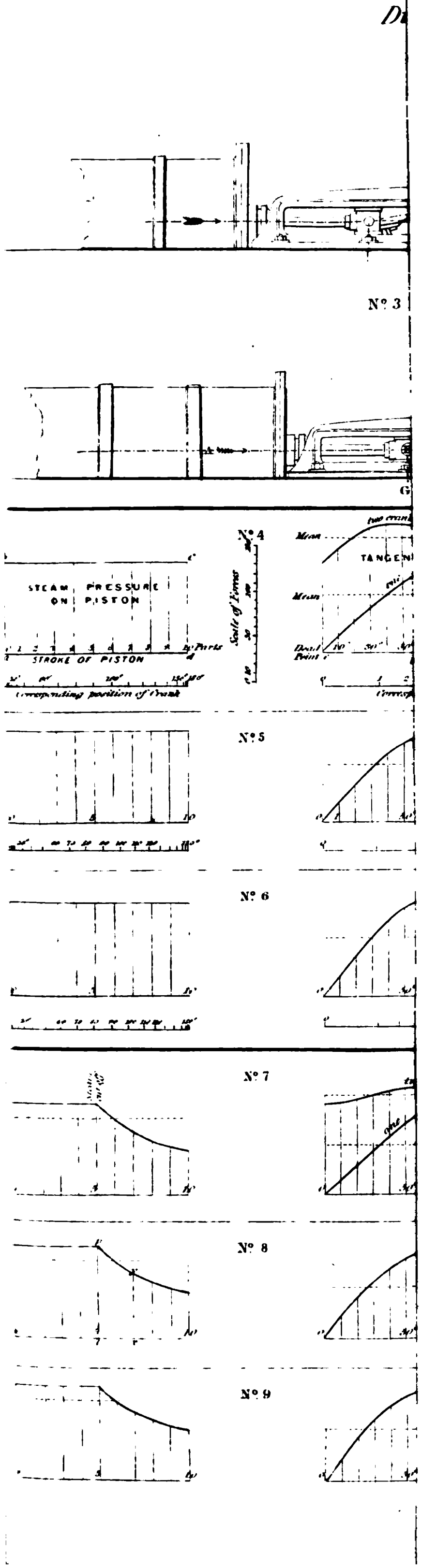
In No. 5 is seen the effect of the connecting rod being made five times the length of the crank. Here the tangential force commencing at 0, arrives at a maximum value of about 102 when the crank has passed through about 80°.

In No. 6, where the connecting rod is three times the length of the crank, the tangential force arrives at a maximum value of about 106 when the crank has passed through about 75°.

It will be perceived, however, that these variations make no difference in the mean force throughout the whole figure, the effect of the connecting rod being merely to vary, in a slight degree, the distribution of the force over the path of the crank pin, without affecting the total amount of power conveyed by it to the machinery. The comparative merits of long and short connecting rods in other points of view, involve considerations which it would be out of place to introduce here.

The return stroke, or the other semi-revolution of the crank, does not exactly correspond with the figures shown in diagrams, 5 and 6, owing to the reversed position of the connecting rod. The nature of the variation will be seen in fig. 6*, where the tangential force is shown for an entire revolution of the crank. It will be observed here, that the force at 10° corresponds with that at 350°, at 60° with 300°, and so on.

Nos. 7, 8, 9, show the effect of cutting off the steam at half the stroke. Here the mean pressure on the piston is = 84·6, and the mean tangential force on the crank pin is = 54,—the equality between the areas of the right and left hand figures being still preserved. The power of the engine is diminished in the proportion of 1000 : 846, although the economy is much increased, as is well known.


No. 3
No. 4
STEAM PRESSURE ON PISTON
STROKE OF PISTON
corresponding position of Crank
Scale of Forces
Mean
TANGENT
No. 5
No. 6
No. 7
No. 8
No. 9

Nos. 10, 11, 12, show the effect of cutting off the steam at one-fourth of the stroke. Here the mean pressure on the piston is = 59·6, the mean tangential force is = 38; and the power of the engine is reduced from 100 to 59·6.

Nos. 9*, and 12*, show the values of the tangential force through an entire revolution of the crank, in the cases above alluded to under corresponding numbers.

*Combined Action of two Engines, with Cranks fixed at right angles to each other.*

The effect of two engines, so coupled, is shown in six cases out of the nine previously described; namely, with three variations in the degree of expansion, and two in the length of connecting rod. The curve of tangential forces is laid down for two cranks in diagrams Nos. 4, 7, 10, 6*, 9*, and 12*; in the three former, for half a revolution, (the other half being precisely similar,) and in the three latter, for a whole revolution of the crank.

It is presumed that these figures will be understood without any further description. As an example, at $\theta$, (No. 9*,) one crank is supposed to have traveled 130° from the dead point, E, (No. 3,) the tangential force on it being expressed by the line, $\theta\rho^1$: the second crank will then have traveled 220° from the same point; and the combined tangential force will be represented by the line, $\theta\rho^2$. The undulations of the upper line will therefore represent the inequalities of the working power in the crank shaft throughout its whole revolution.

*Method of Construction of the Diagrams.*

In laying down the forces in these diagrams, the following points have been assumed:—

(*a.*) That, as long as the steam valve remains open, the pressure of the steam in the cylinder is uniform. This is not always the case in practice, but must generally be assumed in calculation.

(*b.*) That, after the steam valve is closed, the steam expands according to Marriotte's law, the pressure varying inversely as the volume. This is the usual assumption: the causes of variation from this law are treated of in works on the steam engine, but cannot be comprehended in an investigation of the present nature.

(*c.*) That no power is lost by friction, in the transmission of the force through the machine.

(*d.*) The influence of the clearance space on the volume of the steam, in expanding, has been neglected. This is but of small moment, and its introduction would have interfered materially with the simplicity and clearness of the diagrams.

(*e.*) The moving parts are supposed to have no weight or mass; the forces being considered in a statical point of view only.

The curves have been formed by finding the length of ordinates at convenient distances apart, and tracing a curved line through the points thus obtained.

The left hand figures in diagrams Nos. 4 to 12, representing the pres-

sures on the piston, are so simple, that the method of their construction need not be further alluded to than by stating, that the expansion curve, in figs. 7 to 12, is a hyperbola; the property of which is, that (in fig. 8,)

$$\text{As } ox : ol :: lp : xy$$

which follows from Marriotte's law.

The lengths of the ordinates in the right hand figures (the tangential forces) have been found in the following manner:—

Let Nos. 2 and 3, represent a given position of the engine. Draw the tangent, CT. Produce the line of connecting rod, BC; draw CH parallel to AD, and set off CH = the pressure on the piston at that position of the engine. Draw HJ perpendicular to CH; and from the point, J, where it cuts the line of connecting rod, draw JT, parallel to DC, cutting the tangent, CT, in T; then CJ is = the force along the connecting rod, and CT is = the tangential force on the crank pin, which is the ordinate required.

The curves in the diagrams may be expressed by algebraical equations, as follows:—

For the pressure of steam on the piston, in expanding, as shown in the left hand figures, Nos. 7 to 12. Let the pressure on the piston, while the steam valve is open, = P; and let $l$ = length of stroke passed over before the steam valve is closed. Then, if $x$ = any length passed over greater than $l$, and $y$ = the corresponding pressure, we have, by Marriotte's law—

$$y = \mathrm{P}\frac{l}{x}.$$

For the tangential force on crank pin, as shown on the right hand figures, Nos. 4 to 12. Referring again to diagrams Nos. 2 and 3, let

$r$ = CD, the radius of crank,
$c$ = BC, length of connecting rod,
$\theta$ = angle CDE,
$\phi$ = angle CBE,
$z$ = force acting along connecting rod,
$f$ = tangential force required (=CT).

Then, by statical rules, we have, while the steam valve is open,

$$z = \mathrm{P} \text{ Sec } \phi,$$
$$\text{and } f = z \text{ Sin (BCD)};$$

whence, after making all necessary trigonometrical reductions, we arrive at the equation required:

$$f = \mathrm{P} \text{ Sin } \theta \left\{ 1 + \frac{\text{Cos } \theta}{\sqrt{\frac{c^2}{r^2} - \text{Sin}^2 \theta}} \right\}$$

After the steam is cut off, and the pressure in the cylinder becomes variable, we have

$$\text{Pressure on piston} = \mathrm{P}\frac{l}{c + r \text{ Vers } \theta - \sqrt{c^2 - r^2 \text{ Sin}^2 \theta}};$$ which must be substituted for P in the preceding equation.

## *On Electro-Magnetic Clocks.* By PROF. BRANDE.*

Mr. Brande began by adverting to the various opinions which had been entertained in reference to the mutual relations of electricity and magnetism previous to the grand discovery of Oersted, in 1819. As soon as the influence of an electrical current upon a magnetic needle had been developed by the researches of that philosopher, many important applications of the fact almost of necessity suggested themselves, amongst which the wonders of the electric telegraph were to be included. Another result of Oersted's discovery was the electro-magnet; the power, namely, of conferring by proper adjustments of an electric current any degree of magnetism upon a bar of soft iron: and inasmuch as these magnetic energies cease the moment that the electric current ceases, so we have it in our power to render any convenient form of soft iron, such as bars, or horse-shoes, powerful magnets at one moment, and at the next, entirely withdraw all their powers; and this, simply by making and breaking the contacts upon which the flow of electricity from voltaic arrangement depends. In this way a horse-shoe magnet was made alternately to lift and drop a weight, to raise and depress a loaded lever, and to bend and release a spring. These effects were merely due to the attractive force of the electro-magnet upon holders and bars of soft iron, with proper contrivances to prevent the interfering influence of the residuary magnetism which in such cases is more or less retained by the iron core of the coil. Another form of this application of electro-magnetism as a motive power consists in so arranging the electro-magnets that the poles may be alternately inverted, and so made to act upon adjacent permanent bar magnets, both attractively and repulsively. These forms of the apparatus were exhibited. Mr. Brande then stated that on examining Mr. Shepherd's electro-magnetic clocks at the Great Exhibition, he had been especially struck by the excellent illustration which they afforded of the exclusive use of electro-magnetism as their moving power, its force being employed to give impulse to the pendulum, to propel the ordinary movement of the clock, and to effect the striking of the hour; no auxiliary weights or springs being in any case employed. Thinking the whole subject worthy the attention of the members of the Royal Institution, he had applied to Mr. Shepherd for such information and assistance as he required, and Mr. Shepherd had furnished him with the pendulums, clocks, models, and diagrams then before them, and with most useful information in reference to the whole subject. Mr. Brande first explained the mechanism of the pendulum, which is so arranged as to make and break an electric circuit, and consequently to make and unmake a horse-shoe magnet at each vibration. Each time that the magnet is made it attracts its armature, which lifts certain levers; one of these is concerned in raising a weighted lever and causing it to be held up by a latch or detent; the magnet is then unmade in consequence of the pendulum breaking the circuit, and the armature is released, when the pendulum lifts the latch, and allows the weighted lever to fall, which, in falling, strikes the pendulum so as to give it an adequate impulse; then the circuit is again completed, the

* From the London Atheneum, February, 1852.

armature attracted, the levers moved, the weight raised and held up by the detent; another vibration breaks the circuit and releases the armature; the pendulum then raises the detent, the weight falls, and in falling, its arm strikes the pendulum, and gives it an impulse; and so on. But the pendulum at each vibration not only makes and breaks the electric circuit of the battery which maintains its own action, but also, and simultaneously, that of a second battery, of which the duty is to make and unmake the electro-magnets belonging exclusively to the clock or clocks which are upon this circuit. These electro-magnets act upon the extremes of one or more horizontal bar magnets, so as alternately to attract and repel their opposed poles, and which carry upon their axis the pallets, by the alternating motion of which to the right and left, the ratchet wheel is propelled onwards at the rate of a tooth each second, and the axis of this ratchet wheel carries the pinion which moves the other wheels of the clock. The circuit of the battery connected with the striking part of the clock is only completed once in an hour, and is connected with an electro-magnet so arranged as by means of a proper lever to pull the ratchet wheel attached to the notched striking wheel one tooth forward every two seconds, and each tooth is accompanied by a blow on the electro-magnetic bell. The number of blows depends upon the notched wheel, the spaces on the circumference of which are adapted to the number to be struck, and when this is complete, a lever falls into the notch, and in so doing cuts off the electric current, which is not re-established through the striking electro-magnet till the next hour, when a peg upon the hour wheel pushes the striking lever forward so as to cause it to be depressed by a similar peg upon the minute wheel. A very large working model of the clock and of the striking apparatus, constructed for the occasion by Mr. Shepherd, was exhibited, as well as a model of the pendulum and its appendages made under the direction of Mr. C. V. Walter, to whom Mr. Brande was also indebted for a signal bell, on the principle of Mr. Shepherd's clock bells, for the purpose of giving notice to the railway switchmen of the approach of trains in foggy weather.

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## *Contributions to the Physiology of Vision.—Part II.—On some Remarkable, and hitherto unobserved, Phenomena of Binocular Vision. A Bakerian Lecture, delivered by* CHARLES WHEATSTONE, ESQ., F. R. S.*

The first part of these researches was communicated to the Royal Society in 1838, and published in the Philosophical Transactions for that year.

The second part, now presented, commences with an account of some remarkable illusions which occur when the usual relations which subsist between the magnitude of the pictures on the retinæ and the degree of inclination of the optic axes are disturbed. Under the ordinary circumstances of vision, when an object changes its distance from the observer, the magnitude of the pictures on the retinæ increases at the same time that the inclination of the optic axes becomes greater, and *vice versa*, and the perceived magnitude of the object remains the same. The author

* From the London, Edinburgh, and Dublin Philos. Mag., Feb., 1852.

wished to ascertain what would take place by causing the optic axes to assume every degree of convergence while the magnitude of the pictures on the retinæ remains the same; and, on the other hand, the phenomena which would be exhibited by maintaining the inclination of the optic axes constant while the magnitude of the pictures on the retinæ continually changes. To effect these purposes, he constructed a modification of his reflecting stereoscope; in this instrument two similar pictures are placed, on movable arms, each opposite its respective mirror; these arms move round a common centre in such manner that, however they are placed, the reflected images of each picture in the mirror remains constantly at the same distance from the eye by which it is viewed; the pictures are also capable of sliding along these arms, so that they may be simultaneously brought nearer to, or removed further from, the mirrors. When the pictures remain at the same distance and the arms are removed round their centre, the reflected images, while their distances from the eyes remain unchanged, are displaced, so that a different inclination of the optic axes is required to cause them to coincide. When the arms remain in the same positions and the pictures are brought simultaneously nearer the mirrors, the reflected images are not displaced, and they always coincide with the same convergence of the optic axes; but the magnitude of the pictures on the retinæ becomes greater as the pictures approach. The experimental results afforded by this apparatus, so far as regards the perception of magnitude, are the following: the pictures being placed at such distances, and the arms moved to such positions, that the binocular image appears of its natural magnitude and its proper distance, on the arms being moved so as to occasion the optic axes to converge less, the image appears larger, and on their being moved so as to cause the optic axes to converge more, the image appears less; thus, while the magnitude of the pictures on the retinæ remains constantly the same, the perceived magnitude of the object varies, through a very considerable range, with every degree of the convergence of the optic axes. The pictures and arms being again placed so that the magnitude and distance of the object appear the same as usual, and the arms being fixed so that the convergence of the optic axes does not change; while the pictures are brought nearer the mirrors the perceived magnitude of the object increases, and it decreases when they are removed further off; thus, while the inclination of the optic axes remains constant, the perceived magnitude of the object varies with every change in the magnitude of the pictures on the retinæ. After this, the author takes into consideration the disturbances produced in our perception of distance under the same circumstances, and concludes that the facts thus experimentally ascertained regarding the perceptions of magnitude and distance, render necessary some modification in the prevalent theory regarding them.

The author next reverts to the stereoscope and its effects. He recommends the original reflecting stereoscope as the most efficient instrument, not only for investigating the phenomena of binocular vision, but also for exhibiting the greatest variety of stereoscopic effects, as it admits of every required adjustment, and pictures of any size may be placed in it. A very portable form of this instrument is then described, and also a refracting stereoscope suited for daguerreotypes and small pictures not much exceeding the width between the eyes. In the latter instrument the pictures

are placed side by side, and viewed through two refracting prisms of small angle, which displace the pictures laterally, that on the right side towards the left, and that on the left side towards the right, so that they appear to occupy the same place. When the first part of these investigations was published the photographic art was unknown, and the illustrations of the stereoscope were confined to outline and shaded perspective drawings; when, however, in the succeeding year, Talbot and Daguerre made their processes known, Mr. Wheatstone was enabled to obtain binocular talbotypes and daguerreotypes of statues, buildings, and even portraits of living persons; which, when presented in the stereoscope, no longer appeared as pictures, but as solid models of the objects from which they were taken. This application was first announced in 1841.

The two projections of an object, seen by the two eyes, are different according to the distance at which it is viewed; they become less dissimilar as that distance is greater, and, consequently, as the convergence of the optic axes becomes less. To a particular distance belongs a specific dissimilarity between the two pictures, and it is a point of interest to determine what would take place on viewing a pair of stereoscopic pictures with a different inclination of the optic axes than that for which they were intended. The result of this inquiry is, that if a pair of very dissimilar pictures is seen when the optic axes are nearly parallel, the distances between the near and remote points of the object appear exaggerated; and if, on the other hand, a pair of pictures slightly dissimilar is seen when the optic axes converge very much, the appearance is that of a bas-relief. As no disagreeable or obviously incongruous effect is produced when two pictures, intended for a nearer convergence of the optic axes, are seen when the eyes are parallel or nearly so, we are able to avail ourselves of the means of augmenting the perceived magnitude of the binocular image mentioned at the commencement of this abstract. For this purpose the pictures, placed near the eyes, are caused to coincide when the optic axes are nearly parallel; and the diverging rays proceeding from the near pictures are rendered parallel by lenses of short focal distance placed before the mirrors or prisms of the stereoscope.

Some additional observations were next brought forward respecting those stereoscopic phenomena which the author, in his first memoir, called "conversions of relief." They may be produced in three different ways: 1st, by transposing the pictures from one eye to the other; 2d, by reflecting each picture separately, without transposition; and 3d, by inverting the pictures to each eye separately. The converse figure differs from the normal figure in this circumstance, that those points which appear most distant in the latter, are the nearest in the former, and *vice versa.*

An account is then given of the construction and effects of an instrument for producing the conversion of the relief of any solid object to which it is directed. As this instrument conveys to the mind false perceptions of all external objects, the author calls it a Pseudoscope. It consists of two reflecting prisms, placed in a frame, with adjustments, so that, when applied to the eyes, each eye may separately see the reflected image of the projection which usually falls on that eye. This is not the case when the reflection of an object is seen in a mirror; for then, not only are the projections separately reflected, but they are also transposed from one eye to the other, and therefore the conversion of relief does not

take place. The pseudoscope being directed to an object, and adjusted so that the object shall appear of its proper size and at its usual distance, the distances of all other objects are inverted; all nearer objects appear more distant, and all more distant objects nearer. The conversion of relief of an object consists in the transposition of the distances of the points which compose it. With the pseudoscope we have a glance, as it were, into another visible world, in which external objects and our internal perceptions have no longer their habitual relations with each other. Among the remarkable illusions it occasions, the following were mentioned. The inside of a tea cup appears a solid convex body; the effect is more striking if there are painted figures within the cup. A china vase, ornamented with colored flowers in relief, appears to be a vertical section of the interior of the vase, with painted hollow impressions of the flowers. A small terrestrial globe appears a concave hemisphere; when the globe is turned on its axis, the appearance and disappearance of different portions of the map on its concave surface has a very singular effect. A bust regarded in front becomes a deep hollow mask; when regarded *en profile*, the appearance is equally striking. A framed picture, hung against a wall, appears as if imbedded in a cavity made in the wall. An object placed before the wall of a room appears behind the wall, and as if an aperture of the proper dimensions had been made to allow it to be seen; if the object be illuminated by a candle, its shadow appears as far before the object as it actually is behind it.

The communication concludes with a variety of details relating to the conditions on which these phenomena depend, and with a description of some other methods of producing the pseudoscopic appearances.

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## *On a Method of Obtaining a Perfect Vacuum in the Receiver of an Air Pump.* By Thomas Andrews, M. D.*

By using the necessary precautions, a vacuum may be obtained by the following process, with very little trouble, in the ordinary receiver of an air pump, so perfect that the residual air exerts no appreciable elastic force. Even after this limit has been reached, the exhaustion may be pushed still further, till it must become at last not less complete than the Torricellian vacuum; while at the same time, by suppressing the manometer, the existence of mercurial vapor may be altogether prevented. The manipulations required to arrive at this result will not interfere with the presence of the most delicate instruments in the receiver.

Into the receiver of an ordinary air pump, which is not required to exhaust further than to 0·3 inch, or even 0·5 inch, but which must retain the exhaustion perfectly for any length of time, two open vessels are introduced, one of which may be conveniently placed above the other; the lower vessel containing concentrated sulphuric acid, the upper a thin layer of a solution of caustic potash, which has been recently concentrated by ebullition. The precise quantities of these liquids is not a matter of importance, provided they are so adjusted that the acid is capable of desiccating completely the potash solution without becoming itself notably diminished in strength, but at the same time does not expose so

* From the London, Edinburgh, and Dublin Philosophical Magazine, February, 1852.

large a surface as to convert the potash into a dry mass in less than five or six hours at the least. The pump is in the first place worked till the air in the receiver has an elastic force of 0·3 or 0·4 inch, and the stop-cock below the plate is then closed. A communication is now established between the tube for admitting air below the valves and a gas-holder containing carbonic acid, which has been carefully prepared so as to exclude the presence of atmospheric air. After all the air has been completely removed from the connecting tubes by alternately exhausting and admitting carbonic acid, the stop-cock below the plate is opened and the carbonic acid allowed to pass into the receiver. The exhaustion is again quickly performed to about the extent of half an inch or less. If a very perfect vacuum is desired, this operation may be again repeated; and if extreme accuracy is required, it may be performed a third time. It is not likely that any thing could be gained by carrying the process further. On leaving the apparatus to itself, the carbonic acid which has displaced the residual air is absorbed by the alkaline solution, and the aqueous vapor is afterwards removed by sulphuric acid. The vacuum thus obtained is so perfect, that even after two operations it exercises no appreciable tension.

To give a clear conception of the progress of the absorption, I will describe in detail one observation in which the tension was measured simultaneously by a good syphon-gauge and by a manometer, formed of a barometric tube 0·5 inch in diameter, inverted in the same reservoir of mercury as a similar tube communicating with the interior of the receiver. The barometer had been carefully filled, and the depression of the mercury estimated by the method already described at less than $\frac{1}{100\cdot000}$dth of an inch.

Previous to the admission of the carbonic acid, the exhaustion was carried only to 0·4 inch; it was again carried to 1 inch; and a third time to 0·5 inch, after which the apparatus was left to itself. The manometer indicated a pressure in—

| | | | |
|---|---|---|---|
| 15′ | of | 0·25 | inch. |
| 30′ | " | 0·17 | " |
| 80′ | " | 0·10 | " |
| 200′ | " | 0·02 | " |

In twelve hours the difference of level was just perceptible, when a perfectly level surface was brought down behind the tubes till the light was just excluded. In thirty-six hours not the slightest difference of level could be detected. The vacuum has remained without the slightest change for fourteen days.

It is evident that the only limit to the completeness of the vacuum obtained by this process, arises from the difficulty of preparing carbonic acid gas perfectly free from air. This may be very nearly overcome by adopting precautions which are well known to practical chemists. When an extreme exhaustion is required, the gas-holder should be filled with recently boiled water, and the first portions of carbonic acid that are collected in it should be allowed to escape.

The substitution of phosphoric for sulphuric acid would remove the possibility of either aqueous or acid vapors being present even in the smallest amount, but such a refinement will rarely be found necessary.

In the experiment just described, the theoretical residue of air would be $\frac{1}{135\cdot000}$dth part of the entire quantity in the receiver, which would cause a depression of $\frac{1}{4500}$dth of an inch. This result must have been nearly realized. If the exhaustion had been carried at each time to 0·2 inch, the residue by theory would have been only $\frac{1}{3\cdot375\cdot000}$dth part. But the experimental results will not continue to keep pace with such small magnitudes.

*Queen's College, Belfast, January* 7, 1851.

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## *Chemical Report on the Cause of the Fire in the Amazon.* By Professor Graham.*

In reply to the questions arising out of the disastrous loss of the *Amazon* by fire, which are proposed to me for a Chemical opinion, I beg to submit to your Lordships the following statements and conclusions:

The practice of mixing together the various stores of the engineer, consisting of oils, tallow, soft-soap, turpentine, cotton waste, and tow, and placing them in heated store-rooms contiguous to the boilers, must be looked upon as dangerous in no ordinary degree, for several reasons. Although oil in bulk is not easily ignited, particularly when preserved in iron tanks, still, when spilt upon wood, or imbibed by tow and cotton waste, which expose much surface to air, the oil often oxidates and heats spontaneously, and is allowed to be one of the most frequent causes of accidental fires. The vegetable and drying oils used by painters are most liable to spontaneous ignition; but no kind of animal or vegetable oil or grease appears to be exempted from it; and instances could be given of olive oil igniting upon sawdust; of greasy rags from butter, heaped together, taking fire within a period of twenty-four hours; of the spontaneous combustion of tape-measures, which are covered with an oil varnish, when heaped together; and even of an oil-skin umbrella put aside in a damp state. The ignition of such materials has been often observed to be greatly favored by a slight warmth, such as the heat of the sun. I am also informed by Mr. Braidwood, that the great proportion of fires at railway stations have originated in the lamp store, and that in coach works also, when the fire can be traced, it is most frequently to the painter's department, the fire having arisen spontaneously from the ignition of oily matters. Lamp-black and ground charcoal are still more inflammable, when the smallest quantity of oil obtains access to them, and should not be admitted at all among ships' stores.

The stowing metallic cans or stoneware jars of either oil or turpentine in a warm place is also attended with a danger which is less obvious, namely, the starting of the corks of the vessels, or the actual bursting of them by the great expansion of the liquid oil which is caused by heat. These liquids expand in volume so much as one upon thirty by a rise of not more than 60° of temperature, or by such a change as from the ordinary low temperature of 40° to a blood-heat; the latter temperature may easily be exceeded in an engine room. It is remarkable that the burning a few years ago of a large steamer on the American lakes, which

* From the Journal of the London Chemical Society, April, 1852.

even surpassed in its fatality the loss of the *Amazon*, was occasioned by the bursting, in the manner described, of a jar of turpentine placed upon deck too close to the funnel, by a party of journeymen painters who were passengers. This steamer was also on her first voyage, and being newly varnished, the flames spread over her bulwarks and extended the whole length of the vessel in a few minutes.

The bulkheads of coal-holds appear to admit of obtaining considerable security from fire, by being constructed double where close to the boiler, with a sheet of air between the two partitions. The tendency of coals to spontaneous ignition is increased by a moderate heat, such as that of the engine room, from which they would be protected by the double partition. I have obtained instances where coals took fire in a factory, on two different occasions, by being heaped for a length of time against a heated wall, of which the temperature could be supported by the hand; also of coals igniting after some days upon stone flags covering a flue, of which the temperature was not known to rise above 150°, and of coals showing indications of taking fire by being thrown in bulk over a steam pipe. These were Lancashire coals, which are highly sulphurous; but the same accident occurred with Wallsend coals, at the Chartered East Company's works in London, where the coals were twice ignited through a two-feet brick wall, of which the temperature was believed by Mr. Croll not to exceed 120° or 140°.

The surface of deal in the partition opposed to the boiler would probably be better protected from fire by impregnating the wood with a saline solution, which diminishes combustibility, such as the zinc solution of Sir W. Burnett, rather than by coating the wood on the side next the boiler with sheet iron. Indeed, this use of iron appears to introduce a new danger. The iron being a good conductor of heat, the wood below is heated nearly as much as if uncovered, and wood in contact with iron appears to be brought by repeated heating to an extraordinary degree of combustibility, and to become peculiarly liable to spontaneous ignition.

Mr. Braidwood, who has been led to that conclusion, gave an instance of wood covered by sheet iron igniting spontaneously in a wadding manufactory. The numerous occasions, also, on which wood and paper have been ignited by Perkins' heated water pipes, equally exemplify the dangerous consequences which may arise from moderately heated iron in long contact with combustible matter.

The most obvious precautions for guarding against the spontaneous ignition of coal stowed in ships' bunkers, appear to be the taking the coal on board in as dry a condition as possible, and the turning it over, if there is room for doing so, as soon as the first symptom of heating is perceived. An obnoxious vapor is described as always preceding the breaking out of the fire, and affords warning of the danger. The ignition of Newcastle coals in store is not an unfrequent occurrence at the London gas works. It appears always to begin at a single spot, and is met by cutting down upon and removing at once the heated coals. Long iron rods are placed upright in the coal heap, which can be pulled out, and indicate by their warmth the exact situation of the fire. Steam can be of little avail for extinguishing fire among coals in bulk; and water, although

it may extinguish the fire for the time, is too apt to induce a recurrence of the evil.

For extinguishing a fire occurring in berths or cabins in the immediate vicinity of the boiler and engine room, steam might be more advantageously applied, means of turning on the steam being provided upon the upper deck, or other distant place of safety. Steam, however, can only be said to be efficient in extinguishing flame, or a blaze from light objects, and is not to be relied upon beyond an early stage of a fire. Upon a mass of red-hot cinders, the extinguishing effect of steam is insensible.

An essential condition of applying steam with success to the extinction of a fire in the engine room, would be to prevent the rapid ingress and circulation of air at the same time, which is occasioned by the draught of the fires. This could only be done completely by valving the chimnies; for the quantity of heated air passing off by the funnels greatly exceeds in volume the steam produced by the boilers in the same time, and would rapidly convey away the steam thrown into the atmosphere of the engine room, and prevent any possible advantage from it.

The fire in the *Amazon* appeared to the witnesses to take its rise either in the small oil store room situated over the boiler, or in a narrow space of from three to eleven inches in width, between a bulkhead and the side of the boiler, immediately under the same store room. No substance remarkable for spontaneous ignition, such as oiled cotton waste, was actually observed in the store room or the space referred to. The wood itself of the bulkhead, which was within a few inches of the boiler, may have been highly dried and sensibly heated by its proximity to the latter, but is not likely to have acquired any tendency to spontaneous ignition; for when that property results from low heating, it is an effect of time, requiring weeks or months to develope it. The same observation applies to the decks in contact with the steam-chest which incased the base of the funnel.

Nor does it appear probable that the coals in the coal-hold of the vessel gave occasion to the fire by heating of themselves, and then burning through the wooden partition of the oil store with which they were in contact.

These coals were from Wales, and not remarkable for this property.

They are also said to have been shipped in a dry and dusty state, and not damp, a month or two previously.

Their ignition would also have been preceded by the strong odor before referred to, which does not appear to have been remarked, although the coal-hold communicated directly with the boiler room.

Oil was seen to drop from the floor of the store room upon the top of the boiler, but not in greater quantity than might be accidentally spilt in drawing the oil from the tank for the use of the engineers.

A parcel of twenty-five newly tarred coal-sacks, which had been thrown upon the boiler, also obtained, it is supposed, some of the same oil. This oil appears to be the matter most liable to the possibility of spontaneous ignition, which was noticed near the spot where the fire commenced.

But the sudden and powerful burst of flame from the store room, which

occurred at the very outset of the conflagration, suggests strongly the intervention of a *volatile* combustible, such as turpentine, although the presence of a tin can of that substance in the store room appears to be left uncertain. It was stated to be there by two witnesses, but its presence is denied by a third witness. I find upon trial, that the vapor given off by oil of turpentine is sufficiently dense, at a temperature somewhat below 110°, to make air explosive upon the approach of a light. Any escape of turpentine from the heated store room would therefore endanger a spread of flame, by the vapor communicating with the lamps burning at the time in the boiler room, or even with the fire of the furnaces.

The fire appears not to have begun in the tarred sacks lying upon the boiler, although from their position, which was close to the store room, they must have been very early involved in the conflagration, and contributed materially to its intensity. The sacks appear to have been charged each with about two pounds of tar, thus furnishing together fifty pounds of that substance, in a condition the most favorable that can be imagined for rapid combustion. The freshness of the tar and its high temperature would make it ignite by the least spark of flame, although not prone to spontaneous ignition. The burning of a group of newly tarred cottages in Deptford, which came under the notice of Mr. Braidwood, arose from their being set on fire by lightning, while the sun was shining upon them, and the tar liquefied by the heat.

The origin of the fire must remain, I believe, a subject of speculation and conjecture; but the extreme intensity and fearfully rapid spread of the combustion, are circumstances of scarcely inferior interest, which are not involved in the same obscurity.

The timber of the bulkheads and decks near the engine room is reported to have been of Dantzic red wood, or Riga pine, and such was the character of a portion of the *Amazon's* timber which was supplied to me for chemical examination. The wood has had its turpentine drawn off, and differs in that respect from pitch pine. The Dantzic red wood is, in consequence, less combustible than pitch pine, but more porous and spongy. Oil-paint is absorbed, and dries more quickly upon this porous wood than upon oak and other dense woods. After their paint is well dried, pine and other woods certainly acquire from it some protection from the action of feeble and transient flames, which might kindle the naked wood. But the effect of paint, especially of fresh paint, appears to be quite the reverse, when the wood is exposed to a strong although merely passing burst of flame. The paint melts and emits an oily vapor, which nourishes the flame, and soon fixes it upon the wood. There can be no doubt, therefore, that the timber of the *Amazon* was in a more inflammable state than ship timber usually is, from being recently painted, and also probably from its newness and comparative dryness.

But the circumstance which appears above all others to give a character to the fire in the *Amazon* was its occurrence, not in a close hold or cabin, but in a compartment of the vessel where a vigorous circulation of air is maintained by the action of the boiler fires and their chimnies. The air of the engine room must be renewed under this influence every few minutes, and would be so although full of flames rising above deck through the hatchways; for a portion of these flames would always escape

by the funnels, and add to their aspirating power instead of diminishing it. The combustion of bulkheads or decks once commenced in this situation would therefore be fanned into activity and powerfully supported.

The destruction of the floor of the oil store room, and the overturning, in consequence, of the oil tanks and combustibles into the well of the boiler room, was probably the crisis of the fire. A mass of combustible vapor would speedily be generated, and shot about on all sides, of which the kindling power upon the new and painted timber of the bulkheads and decks would be wholly irresistible.

The burning of the *Amazon* impresses most emphatically the dangerous and uncontrollable character of a fire arising in the engine or boiler room, where the combustion is animated by a steady and powerful circulation of air, and the danger of collecting combustible matter together in such a place. The removal of the oil stores to a safer locality is, fortunately, generally practicable, and is the measure best calculated to prevent the recurrence of any similar catastrophe.—*Feb.* 17, 1852.

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## *Silesian Iron.**

**From notice in the *Times* of the Silesian Exhibition of Arts and Manufactures.**

The most extensive display of iron, in all the stages of its manufacture, is sent from the numerous forges or *Hutten* of Count Renard, who alone occupies a large portion of the basement of the building. The quality of the metal produced at his works has secured it a local reputation, though other establishments, as the Laura Works, at Beuthen, produce iron in bar and the larger forms in greater quantity. The Renard Works are unrivalled in the finer sorts, and of hoop iron, nail-rods, wire, cast iron for cooking vessels, steel in many varieties, especially forged steel of the finest quality, there is a most abundant supply. Sheet iron is exhibited from these works of such a degree of tenuity that the leaves can be used for paper. A bookbinder of Breslau has made an album of nothing else, the pages of which turn as flexibly as the finest fabric of linen rags. As yet no extensive application for this form of the metal has been found, but the manager says the material must precede the use for it; perhaps books may hereafter be printed for the tropics on these metallic leaves, and defy the destructive power of ants of any color or strength of forceps. We have only to invent a white ink, and the thing is done. Of the finest sort, the machinery rolls 7040 square feet of what may be called leaf iron from a cwt. of metal. In point of price, however, the Silesian iron cannot compete with English; much is still smelted with wood, and the coal and iron districts lie at great distances from each, so that much capital is consumed by the conveyance of fuel to the works.

* From the London Mechanics' Magazine, June, 1852.

### *Mixtures for Colored Fires.* By Prof. MARCHAND.*

The following recipes for the preparation of mixtures for colored fires were found among the posthumous papers of the late Prof. Marchand. The materials are rubbed to a fine powder separately, and then mixed with the hand:—

*Red.*

61 p. c. chlorate of potash.
16 sulphur.
23 carbonate of strontia.

*Purple-red.*

61 p. c. chlorate of potash.
16 sulphur.
23 chalk.

*Rose-red.*

61 p. c. chlorate of potash.
16 sulphur.
23 chloride of calcium.

*Orange-red.*

52 p. c. chlorate of potash.
14 sulphur.
34 chalk.

*Yellow.*

61 p. c. chlorate of potash.
16 sulphur.
23 dry soda.

*or,*

50 p. c. nitre.
16 sulphur.
20 soda.
14 gunpowder.

*or,*

61 p. c. nitre.
17½ sulphur.
20 soda.
1½ charcoal.

*Light Blue.*

61 p. c. chlorate of potash.
16 sulphur.
23 strongly-calcined alum.

*Dark Blue.*

60 p. c. chlorate of potash.
16 sulphur.
12 carbonate of copper.
12 alum.

*Dark Violet.*

60 p. c. chlorate of potash.
16 sulphur.
12 carbonate of potash.
12 alum.

*Pale Violet.*

54 p. c. chlorate of potash.
14 sulphur.
16 carbonate of potash.
16 alum.

*Green.*

73 p. c. chlorate of potash.
17 sulphur.
10 boracic acid.

*Light Green.*

60 p. c. chlorate of potash.
16 sulphur.
24 carbonate of baryta.

FOR THEATRICAL ILLUMINATION.

*White.*

64 p. c. nitre.
21 sulphur.
15 gunpowder.

*or,*

76 p. c. nitre.
22 sulphur.
2 charcoal.

*Red.*

56 p. c. nitrate of strontian.
24 sulphur.
20 chlorate of potash.

*Green.*

60 p. c. nitrate of baryta.
22 sulphur.
18 chlorate of potash.

*Pink.*

20 p. c. sulphur.
32 nitre.
27 chlorate of potash.
20 chalk.
1 charcoal.

*Blue.*

27 p. c. nitre.
28 chlorate of potash.
15 sulphur.
15 sulphate of potash.
15 ammonio-sulphate of copper.

*From the London Chemical Gazette, May, 1852.

The dark blue is rendered still darker by the addition of some sulphate of potash and ammonio-sulphate of copper.—*Journ. für Prakt. Chem.*, lv. p. 250.

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For the Journal of the Franklin Institute.

## *Steamboats on the Western Waters.* By Samuel H. Gilman, Esq.

To the Committee on Publications.

Gentlemen:—My attention has recently been directed to an article in the May number of your *Journal*, "On the Steamboats of the Western Waters of the United States," containing statements, as manifestly unjust to the character of the enterprising spirit and mechanical skill of the West, as developed in its steam navigation, as the writer was manifestly unacquainted with the past and present history of steam navigation on Lake Erie, the river Mississippi, and its tributaries.

If the fact that a peculiar class of steam vessels, existing in one section of our country, having failed to compete successfully with another class, entirely different in their construction, and existing only in another and distant section, is evidence of "a spirit of prejudice and servile imitation," having produced such a failure, then the engineers of the Atlantic cities are the prejudiced and servile imitators, as the history of steam navigation in the West will abundantly show.

During a long period after steam vessels were introduced into the waters of the Western lakes and rivers, low pressure engines were universally used, with a few trifling exceptions; and in 1825, there was but one high pressure steamboat on Lake Erie, where they now constitute the majority; and there is not a single low pressure steamboat now on the Mississippi, or its tributaries, with the exception of three tow boats below New Orleans. Most of the improvements that have been from time to time adopted on the Hudson and other Northern rivers, up to the present day, have proved failures when transferred to the West; steamboats that were among the most successful on the Hudson, when transferred to the Mississippi, were complete failures, in competition with its high pressure boats. The experiment has often been made, and always with the same results; and boats built in New York, expressly for that purpose, were equally unsuccessful; and a multiplicity of ruinous experiments in building boats in the West on improved plans, successfully adopted elsewhere, have resulted in the present high pressure steamboat in general use on the Western rivers.

Such are the existing facts; and the intelligent observer, who is conversant with the elements which compose Western steam navigation, will not look upon the present high pressure steamboat of the West, as a product of ignorance, prejudice, or servile imitation. There are three principal elements which have combined to produce the present Mississippi steamer, and render it far superior, in its own waters, to the more staunch, elegant, safe, and speedy steamers of the Hudson river, viz: first, the character of the rivers; second, the materials of which boats are constructed; third, the traffic which supports them.

The rivers, especially all the lower ones, flowing through a delta of soft,

alluvial deposit, are exceedingly tortuous, and constantly changing their channels, by cutting away on one side, and leaving sand flats and bars on the other, and in the place of their former channels; the average velocity of the current was found to be (by the late U. S. Coast Survey, Doc. 20, 1st. Session, 32d Congress,) five miles an hour; and the narrowest places where snags most frequently are encountered, the velocity of the current is seven miles an hour. During the best part of the business season, the rivers are filled with drift wood, composed often of whole trees of the largest class, with all their roots and branches attached; immense flat boats, rafts of logs and lumber, and floating ice, are also among the obstructions; it frequently occurs that a boat, in the tortuosity of its course through these obstructions, is taken by the current and swung on to a sand bar; and during the process of sparring off, the water becomes filled with sand, which, in the use of condensing engines, choked the air pump and condenser to such an extent as to form one of the reasons why they were abandoned. The entire absence of wharves, or regular landing places, renders it necessary to keep the outer wheel in motion, to hold the boat to the shore, while receiving or discharging freight; and when on a downward trip, the swift current obliges the boat to "round to," in landing, which in many places would be impossible with a single engine.

Secondly, the best materials for constructing boats, are of such a nature that it is seldom that a boat is run more than four seasons; the dry rot, and frequent grounding at low water, with the heavy loads carried, break them down; hence, the unfinished and temporary appearance of the cabins, which being always on the upper deck, are palaces in size and comfort, but without the elegant and durable finish of northern and eastern steam vessels.

Thirdly, the traffic that supports them, is almost wholly of a merchandise character, and demands a largely preponderating capacity for freight; the cabin being more an accommodation to travelers than a source of profit to the owners. The shoal water demanding a light draft, with a heavy freight, the flat bottom follows, and superior models for speed are prohibited, with the exceptions of a few short routes between large cities, where the passenger traffic alone has been found remunerative, and where condensing engines might be used successfully during high water. It will therefore readily be seen that, in a boat depending upon a merchandise traffic, any excessive weight, or room occupied by machinery, is a constantly accumulating loss, unless met by a corresponding gain in the saving of fuel, from which is to be deducted the difference in the price of condensing and non-condensing engines. The following examples, although not as similar in some respects as could be wished, will show the approximative relative sums of loss and gain, in the use of condensing engines, for a Mississippi freight boat:

The *Magnolia*, described in McAlpine's Report, is propelled by two slightly inclined engines, mounted upon timbers, and which weigh, including the wood in the engines and wheels, boilers, and water, 256,000 pounds; when running between New Orleans and Louisville, she makes two trips a month, or sixteen trips in eight months, the usual season of high water. The *South America*, on the Hudson, has one beam engine, of about the same power as the two of the *Magnolia*, which weighs, in-

cluding timber in engines and wheels, boilers and water, 356,000 pounds, or 100,000 pounds more than the *Magnolia's* two. The average price of freight from New Orleans to Louisville, being 40 cts. per hundred pounds, the 100,000 pounds extra weight of the condensing engine will be a loss in sixteen round trips of $1000 \times 40 = 400 \cdot 00 \times 2 = 800 \cdot 00 \times 16 = \$12,800$; to which is to be added \$1500 per annum for extra cost of the condensing engine = \$14,300 loss by excessive weight of condensing engine per annum; the average cost of the *Magnolia* for fuel per round trip is \$1500 $\times 16 = \$24,000$; suppose that 30 per cent. were saved by the use of the condensing engine, we should have, at the close of the season of sixteen round trips, 30 per cent. on \$24,000 = \$7200 saved, and \$14,300 lost, or a nett loss of \$14,300—7200 = \$7100 by the use of the condensing engines. But the actual loss would be much greater, as will be seen by an inspection of the cost for fuel, of carrying one ton one mile in the respective boats, the gain of speed in the *South America* being more than lost by the loss in fuel and freight capacity.

The *Magnolia* carries 1000 tons of freight from New Orleans to Louisville in six days, distance, 1465 miles, against a five mile current; 144 hours $\times 5 = 720 + 1460 = 2180$ miles $\div 144$ hours $= 15 \cdot 13$ miles an hour, average time; burning 70 cords of wood every twenty-four hours, when running up stream, and 40 cords when running down. According to *Bartol's Marine Boilers*, the *Magnolia* is, all things equally compared, a much more economical boat in fuel than boats using condensing engines generally are. I know this is a startling assertion, yet nevertheless true, according to all known data; but why it is so, is not a part of my intentions to discuss in this paper.

The slightly inclined engines, mounted on timbers, are adopted, because of their lightness, cheapness, and compactness; occupying but six feet on each extreme side of the deck, they leave the cabin entirely unbroken, and the centre of the deck is vacant for the passage or stowage of freight; the boilers being entirely forward of the engines; the valves are worked by cams, which give them their entire movement, either opening or closing during one-eighth of the revolution of the main shaft. They are not only allowed to lift high enough to give an area equal to their own, but they are forced to do it; and they are larger in area than the "usual English or our own Eastern practice." The rule given on page 85 of the *Treatise by the Artizan Club*, 3d edition, calls for an area of 23,758 square inches for a cylinder of 30 inches diameter by 10 feet stroke, making 15 revolutions per minute, with a boiler pressure of 125 pounds per square inch; and Haswell's 5th edition, page 213, calls for an area of 44,750 for the same size engine, number of revolutions, and pressure. The *Magnolia's* valves have an area of 56,745 square inches, and the boats described by McAlpine have an area of steam and exhaust valve generally, if not universally, larger than the "usual English or Eastern practice."

The great difference between boiler and cylinder pressure, as shown by your able Collaborator, does not exist to any thing like the extent that he has shown. There may be contractions in the steam pipes to some extent, but none of the engines from which he dated make the number of revolutions as stated; neither do they carry the pressure of

steam in the boilers. All the Pittsburg packets pass my window every trip, during several months of the year, and I frequently note their number of revolutions per minute. I have traveled several thousand miles on the *Magnolia*, and made frequent observations of the speed of her engines, and they average 14 revolutions when going up stream, and but 10 when going down; and their usual working pressure is 100 pounds per square inch by steam gauge; with the boat light, and burning pitch wood, by extraordinary exertions of the firemen, 15 revolutions have been made per minute, with 140 pounds per square inch boiler pressure. But few of the boats have steam gauges; they state the pressure to which the valve is loaded; the actual working pressure being a mere conjecture.

The great necessity of a competent, disinterested, superintending authority, in the management of the propelling power of our boats, every traveler on our rivers fully appreciates: but that it may be exercised through the medium of condensing engines, is what no man conversant with the existing elements can look for. The experience of from twenty to thirty-five years, of some engineers and companies, with high pressure boats, and without accident to their boilers, has established the impression, if not the fact, that with equal restrictions and ability in management, they are equally as safe as the low pressure or condensing engine boats.

*Baton Rouge, Louisiana, August 2d*, 1852.

Remarks.—We are very glad to hear from our correspondent in defence of the Western Boats; the subject being one which interests every one in our country, and the number of explosions and other fearful accidents with these boats appearing to be largely on the increase: although in view of the late most deplorable and disgraceful sacrifice of the Henry Clay's passengers on the Hudson river, we had better not for the present call the Western kettle, black-face. In the temporary absence from the country, of the gentleman whose remarks have called forth this reply, we will not take issue with Mr. Gilman, in matters which we look upon as of secondary importance, but will call his attention to the point of Mr. Merrick's remarks, which more particularly attracted our notice when the article was published. It is in reference to the extraordinary difference of pressures between the boiler and cylinder. Now what is Mr. M.'s position? He finds in the report of Mr. McAlpine, certain data in reference to the dimensions of the boats and engines of the Mississippi, the pressure of steam which they usually carry, their consumption of fuel, and their speed. Let us observe that this report of Mr. McAlpine is not a mere newspaper article, by one connected with one side or the other, nor even a mere contribution to practical science; but it is the report of a sworn Commissioner, selected from the whole United States for the purpose, to the highest judicial tribunal in our land, and intended to inform and advise that Court in the matter of a suit of no small importance. From such data, then, (which it would seem, ought to secure confidence, if confidence can be given to any statement,) Mr. Merrick proceeded in a manner which is perfectly correct, to calculate the *average working* pressure in the cylinders, and he finds it scarcely one-half of the enormous load which the boilers are required to bear. Following then analogy from

universal experience, he attributes the faults to a supposed erroneous construction of valve and steam passages, which have been heretofore so far as we know never described in detail. Mr. Gilman denies the data, not the inferences, but we are sure that he will see the necessity of accumulating evidence against data got in such a way. The indicator is easily applicable; will he not take the trouble to have it applied on several of the boats (those named in McAlpine's report if possible,) and let us see and publish the cards. That, if fairly done, will settle the question.

It will then be time enough, if it be considered important, to discuss the structure and arrangements of the Western boats; but we now freely concede to Mr. G. that the high pressure boat appears to us the only one applicable to the peculiar navigation of the Mississippi, where low water, strong currents, and inconceivably muddy waters, render the condensing engine entirely inapplicable. We regret, moreover, the language which appears to have given offence; it was probably a hasty expression, which escaped the notice of our correspondent, as it did ours, or it would not have been inserted, for epithets, whether true or false, are of no service in a discussion of this kind.

We shall be glad to hear from Mr. Gilman again on this subject.

Ed.

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## *Improved Lucifer Matches.**

Messrs. J. and E. Sturge, of Birmingham, are now manufacturing on a large scale, a new description of phosphorus for lucifer matches, (called amorphous phosphorus,) which possesses the following advantages over the old: 1, It involves much less risk of destruction of life and property by fire; 2, It is more suitable for matches intended for warm climates; 3, It is not poisonous in the solid form, as that matches made with it will be comparatively harmless if sucked or chewed; and, 4, It does not give off any noxious vapor at ordinary temperature.

The simplest lucifer match consists of a splinter of wood dipped into melted phosphorus, and then covered with gum or glue. More frequently phosphorus is associated with chlorate or nitrate of potass, and with sulphur or sulphuret of antimony. The employment of such materials necessarily renders the manufacture a very hazardous one, from the risk of fire, and in certain of the Continental states the preparation of lucifer matches has been absolutely prohibited. Another and quite unexpected hazard was soon found to attend their manufacture. The work people were attacked by a very painful and often fatal disease of the jaw-bones, which became carious, occasioning in many cases death, in several loss of the upper or under jaw, or other severe mutilation and disfigurement, and always much suffering. The German surgeons, who have paid great attention to this distressing disease, refer it to the absorption of the vapor of phosphorus, given off chiefly during the drying of the matches, but likewise at other stages of the manufacture. Phosphorus, also, is well known to act as a poison when swallowed in the solid form, and as it occurs in this condition in lucifer matches, fatal accidents have more than once occurred from children sucking them.

The red or amorphous phosphorus is much less combustible than ordi-

* From the London Mechanics' Magazine, June, 1852.

nary phosphorus, and not at all poisonous. To prepare the new substance, ordinary phosphorus is melted in a peculiarly constructed retort, and kept for some hours at a temperature of about 500° Fahr. A very singular change is the result of this heating, during which the phosphorus combines with caloric, and renders it latent, but does not otherwise undergo any chemical alteration. The original phosphorus is a pale yellow or white transparent body, so combustible that it must be kept under cold water, and when brought into the air grows luminous even at the freezing point, and enters into full blaze at a temperature of about 150° Fahr. By the prolonged heating it becomes a soft opaque mass, which is easily pulverised, and then forms an uncrystalline powder of a scarlet, crimson, purple-brown, or brown-black color, so incombustible that it may be exposed in summer in the open air, and handled with impunity; nor does it grow luminons till it is about to enter into full combustion at the temperature of 482° Fahr. It is further so harmless to living creatures, that more than a hundred grains have been given to dogs without doing them any injury. Although in its free state, it is sparingly combustible, yet, when it is mixed with the ordinary ingredients of lucifer matches, such as sulphur or sulphuret of antimony and chlorate of potass, it kindles readily.

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*On the Composition of Wootz, or Indian Steel.* By T. H. Henry, Esq., F. R. S.*

The high degree of estimation in which wootz has been held in this country appears to rest more upon the supposition that the celebrated scimitars of Damascus were made from this variety of steel, than on any results obtained with it here; for notwithstanding the late Mr. Stodart, an eminent authority, was of opinion that wootz was superior for many purposes to any steel commonly used in this country, the attempts to bring it into use have not been successful, owing, it is said, to the difficulty of working it.

Under these circumstances, it appeared to me desirable to ascertain as accurately as possible the chemical composition of this steel, with the hope of throwing some light upon the causes of its peculiar physical properties.

An examination of wootz was made by Dr. Faraday in the year 1819.† The amount of carbon was not determined by him; the only substances eliminated were silica and alumina; and he obtained in two analyses 0·0128 and 0·0693 per cent. of aluminium.

From these results Messrs. Faraday and Stodart drew the conclusion, that the peculiar excellence of wootz depended chiefly upon the small quantity of aluminium combined or alloyed with the steel,‡ and this opinion appeared to be strongly supported by ingenious synthetical experiments.

On the other hand, Karsten could only detect dubious traces of aluminium in wootz, and Elsner§ attributed the improvement in the quality of the steel produced in Messrs. Faraday and Stodart's experiments, not to the small quantity of the foreign metals, aluminium, silver, platinum, &c.,

* From the London, Edinburgh, and Dublin Philosophical Magazine, July, 1852.

† Quarterly Journal of Science, vol. vii. ‡ Annales de Chimie, tome xv.

§ Journal fur Prakt. Chimie, vol. xx. p. 110.

alloyed with them, but entirely to the operation of remelting, and this seems to be the practical conclusion come to at Sheffield at the present day. The fact, however, of the perfectly damasked surface obtained in the alloys of Messrs. Faraday and Stodart so closely resembling that of wootz, seems to militate against the conclusions of Elsner.

M. Breant attributes the damask of the Eastern blades to the crystallization of two distinct compounds of iron and carbon, and draws a distinction between the oriental damask and that produced by alloys of steel. This opinion is confirmed by the experiments of M. Anocoff, a Russian engineer, published in the *Annuaire du Journal des Mines de Russie*, a few years back. He pretends to have produced blades so nearly emulating those of Damascus, as to allow of their being bent at a right angle, and capable of dividing a film of gauze floating in the atmosphere.*

I obtained from my friend, Mr. Trenham Reeks, of the Government School of Mines, two samples of wootz, furnished to him by Mr. Lewis Humbert, of the military department of the India House; one was in the form of a cake, such as would be produced by allowing the melted steel to cool in the crucible; the other was forged into a small bar, about four inches long and one inch square, and weighed 4760 grs., or rather more than 11 oz. These are the forms in which it is imported into this country. I preferred operating on the bar, for in steel in this form small particles of slag are often so intimately mixed with the metal as to defy separation; and it is possible, as all the alumina found by Dr. Faraday in wootz was in an insoluble form, that it might have existed as silicate of alumina.

The specific gravity of this specimen was 7·727 at 62° F. The composition was:—

| | I. | II. |
|---|---|---|
| Carbon combined, . . | 1·333 | 1·340 |
| Carbon uncombined, . . | ·312 | ·312 |
| Silicium, . . . | 0·045 | 0·042 |
| Sulphur, . . . . | 0·181 | 0·170 |
| Arsenic, . . . . | 0·037 | 0·036 |
| Iron, . . . . | 98·092 | 98·100 |
| | 100·000 | 100·000 |

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*Cotton as an Element of Industry: its Confined Supply; and its Extending Consumption by Increasing and Improving Agencies.* By Mr. Bazley.†

The lecture consisted of two parts, the first of which treated of the progress of the manufacture; the second, of the sources whence the raw material is supplied. The real commencement of the manufacture in England was at the beginning of the eighteenth century, at which period many causes had conspired to render the country fit for the reception of a new source of industry, and from that time to the middle of the century there was great activity in the domestic manufacture of both cotton and

* A specimen of his damask steel is to be seen in the Museum of the Government School of Mines in Jermyn street.

† From the London Athenæum, April, 1852.

sheep's wool. The weavers of those days had frequently to wait for the hand-spun yarn with which they worked, and hence many ingenious men began to direct their attention to the construction of machinery by which the supply might be increased. Thus, Wyatt, in 1730, discovered the principle of elongating fibre by rollers, and was followed by Hargreaves, Arkwright, Kay, Crompton, and others, the inventors of well known machines. The moving power of these machines had hitherto been the animal force of beasts of burden, or wind and water; but these could not be depended on, and it was reserved for steam to supply a prime mover of greater power and regularity than could be obtained from them. Great improvements were taking place during the same time in the methods of communication. In 1720, the waters of the Irwell and Mersey, between Liverpool and Manchester, had been rendered navigable and useful, in the teeth of the opposition of the pack-horse and wagon interest. In 1758 the Duke of Bridgewater engaged Brindley, the greatest Engineer of his day, to construct a canal for conveying the coal of the Worsley estate to the market of Manchester.

The lecturer here gave an interesting sketch of the labors of Brindley, and of the difficulties which had been overcome by the canals, and subsequently by the railways of England. He paid a just tribute to Lancashire, to the energy of which the first successful canal and railway were both owing. So, too, when gas was proposed for illuminating purposes, a Salford cotton spinner was the first to test its advantages on a large scale.

Mr. Bazley next called attention to the increase in the consumption of cotton wool in this country. At the commencement of the last century it was little more than 1,000,000 pounds weight per annum, while the work people employed on it did not exceed 25,000; but at the close of the century 52,000,000 pounds weight per annum were consumed, and the numbers employed were 125,000. Few articles are more generally applied in manufacture than cotton. Its finest qualities are worked into lace and muslin, while from its very waste excellent letter press paper is made. A very extensive trade has sprung up in Bradford, and other places, in "mixed goods," and "union cloths," which are composed of cotton in combination with worsted, silk, or thread. The cotton manufacture has had many variations, and under the restrictive policy it suffered great depressions, but since the alteration in the fiscal system of the country, a beneficial change has taken place, and the race is now free to all. During the past year, no less than 760,000,000 pounds weight of cotton were consumed in this country, passing through the hands of no fewer than 1,250,000 actual workers, or including their families, three millions and a half of our fellow subjects, an eighth of the population of the United Kingdom, while the exports in 1851 amounted to 30,000,000*l.* sterling. Some idea may be gained of the beneficial nature of this industry to the national treasury, from the fact that 12,000,000*l.* sterling, or one-fourth of the whole revenue, is contributed in taxes by those engaged in it, whilst the area occupied by their operatives is not more than one-hundredth part of the surface of the country. In treating the second part of his subject, Mr. Bazley drew attention to the singular fact, that although the British Colonies contain a greater extent of land suited to the growth of cotton than is to be found under any other dominion, yet that the sup-

ply derived from them is less in quantity and far inferior in quality; the supplies in 1851 were, from foreign countries, 1,569,800 bags; from the Colonies, 333,700 bags. And while 16,000,000*l.* were paid for the foreign cotton, only 2,000,000*l.* were realized by the Colonial. Of this large amount from foreign countries the great proportion comes from America; and individuals are now living who recollect the arrival of the first supplies in 1787; the value of the whole crop being now 30,000,-000*l.*, equal to that of the wheat crop of this country. Surely this is a lesson to other countries possessing equally favorable conditions! The lecturer then glanced at the capabilities of the different British Colonies, for producing this material. The West Indian Islands, Port Natal, and our other African possessions were said to be capable of growing cotton quite as well as the United States; while Australia would produce an unlimited amount equal to the very finest. And lastly, there was the great colony of India, where this plant is indigenous, and where it has been known for 3000 years. The evidence of Dr. Royle, the Botanist of the East India Company, that India can yield an abundant supply of good and useful cotton, was quoted as a ground for the presumption that great blame attaches somewhere; since these expectations have never been realized except in a small degree at Guzerat. This part of the subject was closed by the remarkable statement that a piece of ground of the size of Yorkshire is sufficient to produce a quantity of cotton nearly double the annual consumption of England. It is not to be supposed that this trade is on the decline. One factory inspector, Mr. Horner, reports that in his district only, 81 mills have been started during the past year, employing 14,000 hands. Mr. Bazley then examined minutely the probability of the further and future progress of this great industry, and the means to be adopted to insure it: but into this it will be impossible to follow him in a brief abstract like the present. He concluded by an enumeration of the objects of interest, both in the department of machinery and of fabrics connected with the cotton manufacture, at the Great Exhibition; and with an expression of gratitude to his Royal Highness for having become the champion of arts, manufactures, and commerce, and to the Society of Arts for its share in promoting the success of the Exhibition.—*Proc. Soc. Arts, April* 3, 1852.

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## *Iron Flowers.**

A "fancy piece" has been prepared for the Prussian Exhibition by the Renard Works; it is a vase of polished coal, as solid as black marble, holding a large bouquet of flowers made of sheet iron—leaves, petals, and stems, all perfectly graceful and natural, but sable as night. The effect is singular—the complete imitation having not the least resemblance to nature, unless there are such blossoms on the banks of Acheron: it is Flora in mourning.

* From the London Mining Journal, No. 876.

# FRANKLIN INSTITUTE.

*Proceedings of the Stated Monthly Meeting, August* 19, 1852.

Frederick Fraley, Esq., President, *Pro. Tem.*

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations were received from Hon. Alexander Evans, Hon. John Robbins, Jr., and Hon. Joseph R. Chandler, Members U. S. Congress; Ellwood Morris, Esq., Civ. Eng., Hillsborough, Ohio; Dr. Ranck, Burlington, Iowa, and Owen Evans, Esq., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of July.

The Board of Managers and Standing Committees reported their minutes.

New candidates for membership in the Institute (13) were proposed, and the candidates (2) proposed at the last meeting were duly elected.

The following report from the Committee on the School of Design was read, and the resolutions unanimously adopted:

The Committee on the School of Design for Women, have the painful duty to announce to the Institute the death of Mrs. Anne Hill, the Principal of said school. She left the City a few weeks ago to enjoy a short vacation from the labors of the school, and was one of the passengers on board the steamboat *Henry Clay* at the time such a lamentable destruction of life attended the conflagration of that vessel. Mrs. Hill was one of those drowned in an attempt to escape from the boat, and there seems reason to believe that she fell a sacrifice to her efforts to save a drowning child. She had endeared herself to the committee, to the pupils in the school, and to all its contributors and patrons. Of the uniform devotion and energy which she manifested in the welfare and success of the school by her complete adaptions, personal, moral, and professional, for its management, and by those ready and practical talents, which so remarkably contributed to its usefulness, and to the enjoyment of the public confidence. By this sudden and afflictive dispensation of Providence, the school has been bereaved of a head which it will be difficult, if not impossible, to replace. Her children and family have lost a kind, faithful, and religious mother and relative, and the community has been deprived of one whose career of usefulness in a new and philanthropic effort, was full of the promise of rich and abundant good. Sincerely condoling with all of those who have thus lost one endeared to them by the possession of such gifts, the Committee offer the following resolutions:

*Resolved*, That the sympathy and condolence of the Institute be, and the same are, hereby tendered to the family of Mrs. Anne Hill, to her late pupils, and to her friends, in the great and irreparable bereavement which they have suffered by her death.

*Resolved*, That a copy of this report and the foregoing resolution, be transmitted to the family of Mrs. Hill, by the President of the Institute, and that the same be entered at large upon the minutes, as an humble tribute of our estimation of her worth and usefulness.

# JOURNAL

OF

# THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

# PROMOTION OF THE MECHANIC ARTS.

**OCTOBER, 1852.**


## CIVIL ENGINEERING.

### *A Report of the Engineer in Chief of the Navy, on the Comparative Value of Anthracite and Bituminous Coals.*

Office of Engineer in Chief, U. S. N.,
*February* 24, 1852.

Commodore Joseph Smith, Chief of Bureau of Yards and Docks.

Sir:—In compliance with your instructions, made in conformity to the orders of the Navy Department in June last, to test the comparative value of Anthracite and Bituminous Coals for the purpose of generating steam, I have the honor to report:

That on the completion of the pumping engine of the dry dock of the New York Navy Yard, I caused experiments to be made with Bituminous (Cumberland) and Anthracite (white ash) Coals; and also on the completion of the United States steamer *Fulton*, in January last, I made a series of experiments with the same varieties of coals; the condensed results of all which are herein given. In addition, I would also state, that the United States steamer *Fulton* has been on constant duty several days since the experiments were made, burning constantly *White Ash Anthracite.*

From a letter from her Chief Engineer, H. Hunt, Esq., detailing her performance for the first four days, I extract the following: "The engine worked as well as any I ever saw, but the boilers exceeded my calculations; with clean fires very *easily* keeping forty pounds, cutting off at half stroke *without blowers*. I will here predict that she (the *Fulton*) will do *more* service at *less expense*, than any steamer government will have in five years. Whilst she was out on the first four days I was in her, we were frequently shut off or cutting off to run slow, and turning around, running from one vessel to another, so no calculations could be made of her speed or slip of wheel. The furnace doors were *open full half the time, to keep steam down*, so much more fuel was used than necessary; but the nature of our service was such, that it could not be avoided."

In consequence of the ill health of the Chief Engineer, he was not able to return in her second trip; the results of her consumption of coal on that occasion, are therefore extracted from a letter written by the assistant engineer, S. McElroy, showing the following: "Running time with White Ash Anthracite, January 25 to 28, seventy-one hours. Total coal used, 69,480 pounds, average 992·6 pounds per hour." The above extracts are made, not because they are the most favorable which occur in the log, but as they show the action of the engine and boilers for *several consecutive hours.* Nothing can be smoother than the motion of the engine under ordinary running circumstances; and in relation to the generative power of the boilers, it is more difficult to keep steam *down* than up.

It is unnecessary to use the blowers for ordinary work, as the natural draft proves abundantly sufficient for twenty to twenty-five pounds of steam, with sixteen to eighteen turns; although they are undoubtedly of great value in cases of emergency, and necessary to the prompt and proper management of the fire room, with Anthracite Coal. The *Fulton* will have no difficulty whatever in making twelve knots in ordinary sea weather as long as the bunkers hold out.

A more extended series of experiments would undoubtedly be more favorable to the anthracite, owing to the fact that small quantities were put in the furnaces and almost entirely consumed while the engine was working; it being well known that a small body of bituminous coal will burn longer than the same amount of anthracite spread *thinly* over the grates.

The cost of the two kinds of coals used in the experiments were as follows, at the New York Navy Yard: anthracite $3·90 per ton, bituminous $5·65 per ton.

I have made no comparison of the relative costs of the two kinds of coal, as it may vary according to different localities and periods of delivery, and cannot therefore be considered a fixed element; but have confined the results entirely to their generating powers, deduced from the following experiments:

1. *Experiments with Bituminous Coal, made with the Boilers of the U. S. Steamer Fulton, at the New York Navy Yard, January,* 1852.

The temperature of the water in the boilers being at 38° F., and the temperature of the boiler room 18°, the fires were lighted at ten hours thirty minutes, A. M.

At eleven hours forty minutes, A. M., the temperature of the water was 212° F., and steam began to be generated at the atmospheric pressure. Time raising steam, seventy minutes. The temperature of the boiler room had now increased from 18° to 32° F. At eleven hours fifty-four minutes, A. M., the steam pressure in the boilers was thirty pounds per square inch above the atmosphere. Time of obtaining thirty pounds of steam, one hour and twenty-four minutes, from a temperature of 32° F. Up to this time there had been fed into the furnaces one thousand pounds of dry pine wood, equal to five hundred pounds of coal, and two thousand eight hundred and twenty-six pounds of (Cumberland) bituminous coal. Total, three thousand three hundred and twenty-six pounds.

The engine was now set in operation to work off all the steam which

the above amount of coal would generate, no more being fed to the furnaces. In fifty-three minutes the steam pressure was reduced from forty pounds to five pounds, and the number of double strokes of piston made from forty-one to seven, when the engine was stopped. During the time the engine was in operation, the steam was cut off at half stroke.

The engine consisted of one cylinder, fifty inches diameter, and ten feet four inches stroke. The space between cut-off valve and piston, including clearance, to be filled with steam per stroke, is 3·094 cubic feet. The calculation of the amount of water evaporated is made from the quantities of steam measured out by the cylinder, divided by the relative bulks of steam of the experimental pressures and the water from which it is generated.

The initial pressure of the steam in the cylinder is taken at one pound *less* than in the boilers. The space displacement of piston filled with steam, per stroke, is 70·448 cubic feet, to which must be added the above 3·094 cubic feet, making a total of 73·542 cubic feet.

| Time. | Mean pressure above atmosphere, per square inch in cylinder. | Number of double strokes of piston made. | Cubic feet of water evaporated. |
|---|---|---|---|
| MINUTES. | POUNDS. | | |
| 6 | 32½ | 41 | 10·326 |
| 5 | 25 | 34 | 7·311 |
| 5 | 22½ | 32 | 6·483 |
| 5 | 19¼ | 31½ | 5·879 |
| 5 | 16½ | 31 | 5·352 |
| 5 | 14 | 30 | 4·796 |
| 5 | 11¼ | 26 | 3·797 |
| 5 | 9 | 23 | 3·075 |
| 5 | 7¼ | 21 | 2·631 |
| 5 | 5½ | 12 | 1·393 |
| 2 | 4¼ | 7 | 0·868 |
| | | | 51·911 |

Taking the weight of a cubic foot of sea water at 64·3 pounds, the total weight evaporated is (51·911×64·3)=3337·877 pounds. The boilers of the *Fulton* contained 82,000 pounds of water at the initial temperature of 32° F., which was raised to 212° F., and 3337·877 pounds of it evaporated by 3326 pounds of coal.

Now it requires five times and a half as much caloric to evaporate a given bulk of water from a temperature of 212° F., as to raise it to that temperature from 32° F. The quantity of fuel, therefore, expended in raising the water from the initial temperature to that of 212° F., compared to that expended in evaporating the 3337·877 pounds from that temperature, will be as (82,000×180°)=14,760,000 to (3337·877×990°)= 3,304,498·23, or as 4·4666 to 1·000; consequently, $\frac{3326}{4 \cdot 4666}=744 \cdot 6$ pounds of coal were consumed in evaporating 3337·877 pounds of sea water, or 4·483 pounds of water per pound of coal. It was intended to have made, on the following day, an experiment, under precisely the same circumstances as above, with anthracite; but it was found impossible from the presence of *ice* to work the engine; the experiment was therefore only made so far as regards the time of getting up steam, with the following results, viz:

The fires were lighted with the same *quantity* and *kind* of wood, and

the same *quantity* of coal that had been used the day previous. At seven hours and twenty minutes, A. M., the temperature of the water in the boiler being 38° F., and that of the boiler room 32° F., with the natural draft, the temperature of the water at eight hours and five minutes was 212°, (steam,) and the boiler room 43° F. Time to generate steam forty-five minutes. At eight hours and twenty minutes, the steam pressure in the boiler was thirty pounds per square inch. Time of obtaining thirty pounds of steam from water at 38° F. was *one* hour.

With the bituminous coal, it will be seen that it required seventy minutes to obtain steam from water at the temperature of 32° F., while it only required forty-five minutes with the anthracite; being a difference of time in this respect of about thirty-six per cent. of the bituminous time.

The data for a comparison of the evaporative values of the coals was obtained by another experiment, as follows:

2. *Experiments with White Ash Anthracite, made with the Boilers of the U. S. Steamer Fulton, in New York Bay, January* 1, 1852.

This experiment was made with the steamer under way, while steaming with steady pressure of steam and revolutions of the wheel, as follows:

Steam pressure (*initial*) in cylinder per square inch above the atmosphere, twenty-five pounds; double strokes of piston per minute, twenty-one and one-third; cutting off at from commencement of stroke, three-eighths; consumption of coal per hour, 1800 pounds.

From the above data, there was filled per stroke 52·837 cubic feet of the space displacement of the piston, to which add 3·094 cubic feet of space comprised between cut-off valve and piston, making a total of 55·931 cubic feet of steam of twenty-five pounds pressure, which would be per minute $55{\cdot}931 \times 42\frac{2}{3} = 2386{\cdot}39$ cubic feet, and per hour 143,183·40 cubic feet. Dividing this last number by the relative bulks of steam of the pressure generated, and the water from which it was generated, we obtain $\frac{143183{\cdot}40}{684} = 209{\cdot}332$ cubic feet of sea water, which at 64·3 pounds per cubic foot, amounts to 13,460·047 pounds, evaporated by 1800 pounds of coal, or 7·478 pounds of sea water per pound of coal.

3. *Experiment with White Ash Anthracite Coal, made with the Boilers of the Pumping Engine at the United States Dry Dock, New York Navy Yard.*

A comparative experiment was made with the boilers of the pumping engine at the New York Navy Yard, in October, 1851, on the comparative advantages of anthracite and bituminous coals. All the conditions were as nearly alike as practicable. With the anthracite coal a combustion of 980 pounds per hour, evaporated a sufficient quantity of water to supply the engine with steam of twelve pounds pressure above the atmosphere, per square inch, for 425 double strokes of piston per hour, the steam pressures being alike in both cases; the economical values of the coals will be represented by the number of double strokes of piston made, divided by the quantity of fuel per given unit of time; or will be anthracite $\frac{425}{980} = 0{\cdot}4337$: bituminous $\frac{294}{1100} = 0{\cdot}2673$, or the anthracite is better than the bituminous in the proportion of $\frac{0{\cdot}4337}{0{\cdot}2673} = 1{\cdot}623$ to 1·000.

It is proper to remark, that these boilers were expressly designed for burning *bituminous coal.*

COMPARISON.

The coals used in these experiments were the kinds furnished by the agents of the government for the use of the United States Navy Yard and steamers, and was taken indiscriminately from the piles in the yard, without assorting.

The bituminous was from the "Cumberland" mines; the anthracite was the kind known as "White Ash Schuylkill."

From the preceding data, it appears that in regard to the rapidity of "getting up" steam, the anthracite exceeds the bituminous thirty-six per cent.

That in economical evaporation per unit of fuel, the anthracite exceeds the bituminous in the proportion of 7·478 to 4·483, or 66·8 per cent.

It will also be perceived, that the result of the third experiment on the boilers of the pumping engine at the New York Dry Dock, which experiment was entirely differently made, and calculated from the first and second experiments, gave an economical superiority to the anthracite over the bituminous of 62·3 per cent.; a remarkably close approximation to the result obtained by the experiments on the *Fulton's* boilers, (66·8 per cent.,) particularly when it is stated that the boilers and grates of the pumping engine were made with a view to burning bituminous coal, which has been used since their completion; while those of the *Fulton* were constructed for the use of anthracite. The general characters of the boilers were similar, both having return drop flues.

Thus it will be seen, from the experiments, that, without allowing for the difference of weight of coal that can be stowed in the same bulk, the engine using anthracite could steam about two-thirds longer than with bituminous.

*These are important considerations in favor of anthracite coal* for the uses of the Navy; without taking into account the additional amount of anthracite more than bituminous that can be placed on board a vessel in the same bunkers, or the advantages of being free from *smoke,* which in a *war*-steamer may at times be of the utmost importance in concealing the movements of the vessel, and also the almost, if not altogether, entire freedom from spontaneous combustion.

The results of the experiments made last spring on the United States steamer *Vixen* were so favorable, that I recommended to the Bureau of Construction, &c., the use of anthracite for all naval steamers at that time having, or to be thereafter fitted with *iron* boilers; particularly the steamers *Fulton, Princeton,* and *Alleghany,* the boilers for all of which were designed with a special view to the use of *anthracite,* and with the approval of that Bureau.

The *Fulton's* bunkers are now filled with anthracite, and the consumptions referred to in the engineer's report on that steamer show, during the short time she has been at sea, that the anticipated *economy* has been fully realized.

In view of the results contained in this report, I would respectfully recommend to the Bureau of Yards and Docks, the use of anthracite in the

several Navy Yards, and especially for the engine of the Dry Dock at the New York Navy Yard.

In conclusion, I desire the approval of the Bureau to make such investigations as my duty will permit, with regard to the *experience* of the durability of *copper* boilers, when used with bituminous or anthracite coal; which can be done without any specific expenditure.

The inquiry may prove highly important to the Navy Department, as the use of anthracite under copper boilers has been heretofore generally considered as more injurious than bituminous coal, and is consequently not used by government in vessels having copper boilers.

Respectfully submitted by your obedient servant,
CHAS. B. STUART, *Eng. in Ch., U. S. N.*

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*Letter of the Engineer in Chief of the Navy, in relation to Coals, addressed to the Chairman of the Committee on Naval Affairs.*

OFFICE ENGINEER IN CHIEF, U. S. N.,
*May* 27, 1852.

SIR:—The Senate, by resolution, having called for my reports to the Navy Department, giving the results of several experiments to test the relative value of anthracite and bituminous coals for generating steam, and referred the same to the Committee on Naval Affairs, I have thought that the results obtained from additional tests and experiments, made in this country and England, would be of service to the committee, and trust that the importance of the subject, both to the interests of the government and of individuals, will be considered a sufficient apology, if any be needed, for the liberty I have taken in addressing you this communication.

It should be remembered that what is required to be known on this subject, is neither the absolute nor relative evaporation by coals under conditions that never occur in practice, (as too many experiments are conducted,) but the facts to be determined are, the results which can be obtained from them under the ordinary circumstances in which they are used in marine boilers.

With this view I have prepared the following tabular statement, showing the actual evaporation of water effected by bituminous and anthracite coals in the boilers of several naval steamers, and in those of some transatlantic and river steamers plying to and from New York the past few years.

This table, therefore, from being prepared with care from the steam logs of the different vessels, (those of the navy being on file in this office,) is of great value; more so, undoubtedly, than if the results had been obtained from a series of special experiments made under circumstances not normal to the practice, which results, therefore, must be extensively modified before they could be received for practical guides.

The table includes all the cases I have been able to obtain at this time, where the data were unexceptionable; it extends in most instances over a course of several years steaming, and the average evaporation thus obtained, although not equal sometimes to the maximum of special experiments, is, in my judgment, more entitled to confidence than any single experiment made with greater critical accuracy, but on too small a scale for trustworthy results.

Of the latter character, I should rank those of W. R. Johnson, Esq.,

made under the directions of the Navy Department, in 1843, in the Report of which he states that "on each sample of coal were made from one to six trials, according to the quantity furnished. The coal consumed in one trial never exceeded 1567 pounds—this being the greatest quantity which the apparatus could receive in the period allotted to each experiment, including the time required for cleaning out the residue, making the necessary adjustments, and preparing for a new trial. The total weight of coal consumed in the trials of evaporative power has been nearly sixty-two and a half tons; and the weight used, on an average, nine hundred pounds per trial"—being less, it will be seen, than half a ton per trial, or not three tons for the greatest number of trials made with any one kind of coal, not equal to a two hours' consumption of an ordinary sea steamer.

These experiments were not only very limited in their extent, but were made with a boiler entirely different in its construction from those in naval and sea steamers, and not at all adapted for that service, and cannot therefore be compared in value to the following practical tests, deduced from the consumptions of hundreds of tons of coals on each steamer named and in actual service.

*Table of Practical Tests of Different Varieties of Coal.*

| Names of Vessels. | Trade. | Sea water evaporated from temperature of condenser (100 deg. Fahrenheit) by 1 lb. of bituminous coal. | Sea water evaporated from temperature of condenser (100 deg. Fahrenheit) by 1 lb of anthracite coal. | Remarks. |
|---|---|---|---|---|
| | | *pounds.* | *pounds.* | |
| Michigan, | United States Navy, | *5·000 | | Fresh water. |
| Mississippi, | do. do. | †4·780 | | Sea water. |
| Spitfire, | do. do. | †4·870 | | do. |
| Engineer, | do. do. | ‡4·531 | | do. |
| Alleghany, | do. do. | †5·600 | | do. |
| Iris, | do. do. | †5·180 | | Sea water & old flue boil. |
| Princeton, | do. do. | †6·666 | | Sea water and new boil. |
| Princeton, | do. do. | §5·372 | | do. do. |
| Princeton, | do. do. | | 7·554 | do. do. |
| Princeton, | do. do. | | 6·639 | Sea water and old boilers. |
| McLane, | U. States Treasury, | | 7·030 | Sea water. |
| Bibb, | do. do. | | 6·030 | do. |
| United States, | Transatlantic pack't | | 7·480 | do. |
| Herman, | do. do. | †4·487 | | Sea water and old boilers. |
| Baltic, | do. do. | | 8·555 | Sea water. |
| City of Pittsburg, | do. do. | †4·930 | | do. |
| New World, | Hudson River, | | 8·022 | do. |
| Commodore, | Long Island Sound, | | 7·262 | do. |
| Roanoke, | N. York & Norfolk, | | 6·554 | do. |
| | | 10)51·416 | 9)65·116 | |
| | Averages, | 5·142 | 7·235 | |

From the averages of the above table, it will be seen that the econo-

* Pittsburg Coal. † Cumberland Coal. ‡ Virginia Coal. §Scotch Coal.

mical evaporation by the anthracite exceeded that by the bituminous in the proportion of 7·235 to 5·142, or about 41 per cent. of the latter.

In the experiments made on coals by Playfair and De la Beche, by order of the British Government, in 1848, I find eleven varieties of Welsh coals having a constitution almost identical with the nine specimens of various Pennsylvania anthracite, experimented on by Johnson, viz:—

| | Welsh anthracite. | Pennsylvania anthracite. |
|---|---|---|
| Fixed carbon, | 87·54 | 88·54 |
| Sulphur, | 0·79 | 0·05 |
| Other volatile matter, | 5·50 | 5·17 |
| Earthy matter, &c., | 6·48 | 6·51 |
| | 100·31 | 100·27 |

The average evaporation of water by the Welsh anthracite and by the Pennsylvania anthracite was as follows:

Fresh water evaporated from a temperature of 212° F., by one pound of coal.

By Welsh anthracite, . . . . . . . . 9·263 pounds.
By Pennsylvania anthracite, . . . . . . . . 9·590 "

Thus far there is a very close agreement between the results obtained by the different experimenters from substantially the same coal—that coal being anthracite.

In the experiments of Playfair and De la Beche, above cited, I find three varieties of Welsh bituminous, three varieties of Scotch bituminous, and one variety of English bituminous, having a constitution almost identical with the five specimens of Maryland (Cumberland) bituminous coal experimented on by Johnson.

| | Welsh, Scotch, and English bituminous | Maryland (Cumberland) bitumin. |
|---|---|---|
| Fixed carbon, | 75·00 | 75·05 |
| Sulphur, | 1·47 | |
| Other volatile matter, | 14·55 | 15·45 |
| Earthy matters, &c., | 8·97 | 9·49 |
| | 99·99 | 99·99 |

The average evaporation by the Welsh, Scotch, and English bituminous, and by the Cumberland bituminous, was as follows, viz:

Fresh water evaporated from a temperature of 212° F., by one pound of coal.

By Welsh, Scotch, and English bituminous, . . . 8·02 pounds.
By Maryland (Cumberland) bituminous, . . . 9·93 "

Here is a great discrepancy between the results obtained by the two experimenters on substantially the same coals; Johnson making the Cumberland bituminous better than the British bituminous in the proportion of no less than twenty-four and a half per cent. of the latter. Had a similar difference been found in the case of anthracite between the results of the two experiments, it might have been accounted for by a difference of boiler or method of conducting the experiments.

From an investigation of the two kinds of boilers employed, I am of opinion that though in their proportions separately different, yet in the aggregate they were equivalent; an opinion justified also by the equality of results obtained with anthracite.

The results, then, of Johnson's experiments are, that Cumberland bituminous exceeds the Pennsylvania anthracite in economical evaporation, four per cent. of the latter; while the results from the English experiments, on substantially the same coals, make the economical evaporation of the anthracite to exceed that of the bituminous over twenty-four per cent. of the latter.

I would here beg leave to remark that there were several important facts attending the experiments of Prof. Johnson, which, rightly understood, would greatly modify his results; and which facts it is absolutely necessary to consider in order to arrive at correct practical information. One of the most important of these is the rapidity of combustion, which is ordinarily measured by the number of pounds of coal consumed per hour per square foot of grate surface, the average quantity of which in marine boilers may safely be taken at fifteen pounds.

In Johnson's experiments, however, the consumption of Cumberland bituminous coal was at the rate of only 7·11 pounds, and of anthracite 6·43 pounds; an average of less than half the practical rate of consumption.

It is obvious, therefore, that the rapidity of combustion being an important element in determining the evaporative efficiency of different coals, that in any experiments made to ascertain this efficiency for marine boilers, the rapidity of combustion should be about the average of what occurs in actual practice at sea.

Again: the importance of the rate of combustion in effecting the results to be obtained from anthracite or bituminous coals, are well signalized in the following extract from a paper by Chief Engineer Isherwood, U. S. Navy, published in *Appleton's Mechanic's Magazine*, for October, 1851, page 621, viz:—

"In the combustion of bituminous coal, *time* is the important element, and a slow rate of combustion with low velocity of draft is necessary for obtaining high evaporative results, and for the following reasons, viz: The bituminous portion of the coal is volatilized and separated from the fixed carbon part at a lower temperature than is required for its ignition, that is, than is required for its chemical union with oxygen. In this gaseous state, occupying the furnaces and flues of the boiler, it can only be ignited by being mixed with atmospheric air at a sufficiently high temperature; the element of time is, therefore, doubly important; first, to allow the gases to become intimately mixed with the atmospheric air; second, to allow them to acquire the necessary high temperature. If now, by means of a powerful draft, the gases, having only the low temperature due to their volatilization, be driven so quickly through the flues and out of the chimney of the boiler as not to allow them time enough to acquire the proper temperature for combustion, and to have the proper mixing with the atmospheric air, a great loss of effect must inevitably follow.

"For the economical combustion, then, of bituminous coal in generating steam, there should be a slow rate of burning, or a small amount consumed per unit of time per unit of surface."

In the combustion of anthracite coal, however, the above general observations do *not* apply. Considering the principal portions of the anthracite to be fixed carbon, there will of course be no volatilization of bitumen

at a lower temperature than what is required for the ignition of the fixed carbon; the coal will consequently remain unchanged until the temperature is sufficiently high for its combustion, that is, for the combustion of its fixed carbon; a forced draft cannot, therefore, carry off the fuel before it is ignited, and in this view, velocity of draft is comparatively unimportant. Again, combustion with the anthracite is effected solely by the contact of the air with their solid surfaces; there is therefore no mixing to be done, and consequently no time required to do it in. Here, then, under two important conditions, great velocity of draft, which is highly detrimental to the economical combustion of bituminous, is unimportant in the combustion of anthracite coal."

Taking the above views to be correct, which it is believed they are, it will be perceived that the very *slow* rate of combustion used with the bituminous coal in Johnson's experiments, (a rate utterly out of question with marine boilers,) was in *the highest degree favorable for the development of the full heating power of the bituminous coal;* now as this rate of combustion is impracticable in marine engines, a very great correction for inferior results to be obtained by the faster rate of combustion must be made, in order to obtain their *practical value.* With the anthracite, the very slow rate of combustion used was positively a *disadvantage*, as it could not keep the *whole* mass sufficiently high to enable the fixed carbon to take up the oxygen of the air as fast as the latter entered; consequently it exerted, in a considerable degree, a *cooling* power.

Further, it is generally acknowledged that the quantity of *carbon* in coals is at least an index, if not a full measure of their practical heating power. This idea is entertained by Johnson himself, and is announced in his work on coals, published in 1850, pages 118, 123, and 124, viz:

"The British experimenters continued their analysis of the coals till every sample had been submitted to both proximate and ultimate determination. In the American experiments time was not allowed before the report was demanded, for extending the ultimate analysis to more than one-eighth part of the samples. From such trials as were made, the deductions which appeared to be authorized by a careful comparison between the constituents of the coals and their *evaporative efficiency* was, *that the latter depended upon the total amount of carbon in the coal.* If hydrogen had been, as many European chemists had contended, the more efficient element, weight for weight, then all highly bituminous coals ought to have presented a greater heating power than those of lower bituminousness."

"Both the American and British experiments concur in proving the *reverse of this to be the fact.*"

"This development finally *sets aside the old calculations about the relative heating powers of carbon and of the hydrogen in coals.* By the principle of that calculation, any coal having a high degree of bituminousness ought, in consequence of the large proportion of hydrogen in its bitumen, to possess a much higher heating power than any coal of lower bituminousness. *The reverse of this is true. The higher the bituminousness, or, in other words, the greater the proportion of volatile matter a coal contains, the less is its available heating power.* The fact has been pointed out in former publications of the writer, that when solid hydrogen (that being its state in coals) is converted by the effect of heat into gaseous hydrogen, it

requires for this change a large amount of heat, as experimentally proved in the manufacture of illuminating gas. The hydrogen thus brought to the gaseous state, assumes the same bulk at a given temperature, say 212°, as it will retain at the same temperature when converted into vapor of water under the atmospheric pressure; and consequently, unless we can suppose the capacity for heat of gaseous hydrogen, bulk for bulk, to be greater than that of the vapor of water, we can conceive no reason why it should give out more heat in combining with oxygen than it had taken up in being converted into gas. The British Commissioners refer to this view of the subject, but do not clearly express an opinion of its validity.

"Fortunately, their silence is of less importance, as their own experiments furnish abundant proofs of the correctness of the principle. In order more clearly to exhibit the independence of *hydrogen efficiency* in computing heating powers of analyses, we have placed in the above table the per centage of hydrogen found in each sample of coals. From this column the averages are deduced, and a glance will show, that so far as any law or relation is perceptible, the *coals of highest heating powers are those which have the lowest per centage of hydrogen.*" The table above referred to condensed from Johnson, stands as follows, viz:

| | Hydrogen. | Carbon. | Steam by experiment. | Steam by calculation. |
|---|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Pounds.* | *Pounds.* |
| Four coals, average, . . | 4·13 | 74·15 | 7·78 | 8·03 |
| Do. do. | 4·30 | 76·63 | 8·35 | 8·37 |
| Do. do. | 4·57 | 79·67 | 8·65 | 8·60 |
| Do. do. | 4·88 | 81·06 | 8·89 | 8·75 |
| Do. do. | 4·17 | 85·68 | 9·17 | 9·25 |
| Do. do. | 4·55 | 88·12 | 9·50 | 9·51 |
| Do. do. | 4·47 | 88·99 | 9·75 | 9·75 |

"Thus the four coals having a heating power of 7·78, have excess of hydrogen 4·13; the four having heating powers of 9·17, have of oxygen in excess 4·17. It will also be noted that an intermediate class of coals having a heating power of 8·65, has a higher per centage of hydrogen than either of the above, viz: 4·57. This is as we might expect to find it, if the *hydrogen be truly without efficiency in the practical use of coal. Indeed, the hydrogen appears from the practical tests thus far adduced, no more to merit the consideration as an element of evaporative efficiency in coal, than an equal weight of silicia, alumina, oxide of iron, or other inert substance found in its earthly residuum or ash.*"

It appears to be difficult to reconcile the foregoing and well established facts, with the numbers given by Prof. Johnson as the results of his experiments on anthracite and Cumberland (bituminous) coals, the former containing 88·54 per centum of carbon, and the latter only 75·05 per centum, while he makes the latter *four per centum* better than the former, while it should have been as above demonstrated, the reverse in the proportion of 88·54 to 75·05, or eighteen per centum.

The results of the British improvements on substantially the same coals,

viz: containing relatively 87·54 and 75 per centum of carbon, gave for the former a greater efficiency of twenty-four and a half per centum, making a difference in the results of over twenty-eight per centum.

A large number of experiments and practical tests might be cited to further prove the greater efficiency of anthracite over bituminous coals, in proportion very nearly as the element of carbon was found; but they would swell this paper, now already too extended. I have therefore confined the comparison to a few experiments of admitted correctness, to illustrate the facts, and in conclusion would add, that I agree fully with the views expressed in Professor Johnson's report, "that for the purpose of steam navigation, therefore, the rank most important to be considered (in different coals) is in the order of their evaporative power under given bulks. This is obviously true, since, if other things be equal, the length of a voyage must depend on the amount of evaporative power effected by the fuel which can be stowed in the bunkers of a steamer, always of limited capacity. With this scale of value, however, must be combined the relative freedom from clinker, and the maximum rapidity of action; while the rapidity of ignition is of inferior importance, but may deserve some consideration where short voyages, frequent stoppages, and prompt commencement of action are demanded." All of which qualities I think have been from practical results found to be more fully combined in the white ash anthracite of Pennsylvania than any other known coal. I therefore fully concur in the opinion of Professor Johnson, expressed in his work on coals, published in 1850, page 160:

"In conclusion I may observe, that while these analyses demonstrate the high density and compactness of this coal, (anthracite,) fitting it for the purposes of steam navigation, for which these qualities, combined with great heating power, are of primary importance, they also show, that for the various arts and for domestic consumption, its properties are calculated to sustain the high character of the central coal-field of Pennsylvania, for the concentrated and durable heat which it furnishes, and the absence of those ingredients which might interfere with its useful application."

I have the honor to be, sir, with great respect, your obedient servant,

CHARLES B. STUART, *Eng. in Ch., U. S. N.*

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## *Law Expenses of Railways in Great Britain.**

The Court of Common Pleas was asked the other day to grant a rule calling on the Master to review his taxation of plaintiff's attorney's bill, in the case of Edwards and another, assignees of Parker, *v.* the Great Western Railway Company. The Court appears to have been much moved at the application.

In that bill a little item (among others) of £1300 occurred as the charge for the "notice of action." It seems the Master had knocked off £1000 of it, leaving the odd £300 to be charged. Now £300 seems to our sim-

* From Herapath's Journal, No. 678.

ple mind pretty fair for the mere preliminary step of a "*notice* of action." When all the gold from California and Australia comes, perhaps we might be more liberal in our notions; but as long as gold remains as dear as it is, we fear we shall never think of a "notice of action" costing £300 without shuddering; and yet the £300 is less than a fourth of the sum charged. The Chief Justice was, however, as illiberal in his remarks as we are, for he said that even "the allowance made by the Master (£300) was overmuch."

This notice of action had taken *three years to prepare;* had occupied no less than *ten clerks;* consisted of *forty-one folio volumes;* and the time consumed in work upon it was 6666 *hours!!!*

Before the "notice of action" came to light, we thought the most wonderful thing in the railway world was an act of incorporation for one company costing £600,000. But the "notice of action" completely takes "the shine out" of that.

We trust the 41 folio volumes of the "notice of action" will be carefully preserved. The Great Western Railway Company, the unfortunate party on whom the "notice" was served, should have them handsomely bound, and on the back of each have it labelled in gilt letters—"Notice of Action by one of the carriers on the line." We do not know whether the Great Western Company have any book-case large enough to contain all the folio volumes; if not, we think we know a party who would be very glad to provide, *gratis*, a place for them—the Great Exhibition Company. Mr. Russell could not confer on a brother railway Chairman a greater boon than to allow Mr. Laing the loan of these volumes of notice of action, for public exhibition in his Crystal Palace. We are confident it would draw a vast concourse of sight-seers to Sydenham.

Mr. Russell cannot be expected to give outright the notice of action to his railway friend. It has, at the much reduced price, cost the Great Western an enormous sum—£300, or more than £7 a volume; the original, but disallowed charge, having been £1300, or about £30 a volume. It is true, that costly as this library is, the intrinsic value of it is just about as much as the purchaser of waste paper would give for it.

> "The proper price of a thing
> Is just as much as it will bring."

Although "the notice of action" might be nothing but waste paper in intrinsic value, yet, if it will "show" and attract a great many to the new Crystal Palace, it has a value which it is difficult to estimate. Therefore, the Great Western may not have been forced into an expenditure so unproductive as at first sight appears. On the contrary, if Mr. Laing's Crystal Palace Company be favored with the loan of it, the Great Western ought to be paid at least good interest upon the outlay; and if Mr. Laing should not have it, then possibly a show room at the Paddington station could be fitted up, and derive to the Great Western Company a large income at the small charge of only a penny a peep. Scarcely a passenger on the crowded Great Western Station would object to give a penny to see what the 41 volume "notice of action" was like.

## *Lackerstein's Patent Carbonic Acid Gas Engine.**

Mr. J. F. Lackerstein has patented some improvements in obtaining motive power, which consist of certain combinations of means and apparatus for obtaining power by the use of carbonic acid gas. The apparatus employed for generating the gas, and bringing it to a fit condition for use in the engine, consists of three vessels—a generator, a purifier, and an expander. These vessels are each of a cylindrical form, with hemispherical ends, and are connected with each other by suitable arrangements of pumps and pipes. The materials from which the gas is obtained (and which the patentee prefers to be sulphuric acid and carbonate of soda in solution, or other equivalent materials yielding residuary products of commercial value,) are pumped in atomic proportions into the generator, and caused to combine intimately by traversing a percolator filled with broken glass or other such materials, whereby an extended surface is obtained. After passing through the percolator, the used materials are collected at the bottom of the vessel, and discharged from time to time by means of a self-acting float valve, which rises from its seat when the liquid has attained a certain level, and falls again and closes the exit orifice when, by the discharge of part of the liquid, the level of the liquid in the generator is reduced. In order to prevent the float being crushed by the pressure of the gas, it is perforated at the top, whereby gas is admitted, and the interior filled at the same pressure as exists in the generator. The falling liquid from the percolator is prevented from entering the float by a shield, which serves to disperse it, and keeps it from contact with the open part of the float. The gas produced in the generator is pumped into the purifier, where it is passed through water, and from which is supplied to the expander by a double plunger pump of a peculiar construction. The expander is surrounded by a jacket in which steam, hot air, or hot water is caused to circulate, and the pressure of the gas is thereby much increased, or the use of a current of electricity may be adopted for the same purpose. From the expander the gas passes to the cylinder of the engine, where it actuates a piston in precisely the same manner as steam is caused to act on the piston of a steam engine. After performing its duty in the cylinder, the carbonic acid is passed through a vessel, containing in solution some chemical substance, capable of combining with it to form a material, which on being concentrated or evaporated to dryness, may be again used in the production of carbonic acid gas. Those portions of the apparatus which are liable to be corroded by the acid employed, are to be protected by a covering of gold or platina, or to be formed of those metals. With the same view, the interior of the generator is lined with sheet lead. Although sulphuric acid and carbonate of soda are the substances which the patentee prefers to use for producing gas for the purposes of his invention, he does not confine himself thereto, but uses bi-carbonates and sesqui-carbonates of soda, and carbonates of other alkalies and other acids than sulphuric, as also substances with an acid reaction; the object which he has in view being to obtain at the same time with the production of gas residuary

* From the London Mining Journal, No. 877.

materials of commercial value. Thus, from sulphuric acid, and carbonates of soda, potash, or ammonia, are obtained residual sulphates of those bases; from nitric acid with the same bases, valuable nitrates; from boracic acid and soda, the borax of commerce; from alum, with potash or soda, valuable fertilizing salts; from chromic acid and potash, chromate of potash, a compound valuable in dyeing; and from hydrochloric acid and ammonia, sal-ammoniac of commerce. These, however, are merely given as examples.

*Claims.*—1, The employment of the specified materials when corrosive acids are used, in the construction of the pumps and other parts of the apparatus. 2, The use of a percolator, whereby the materials forming the gas are more intimately mixed together by passing through a more extended surface. 3, The self-acting float valve, whereby the residuary matters collected at the bottom of the generator are discharged from time to time. 4, The purifier, whereby the carbonic acid gas is purified before being used, to prevent any injurious effect on the engine. 5, The pumping the gas into the expander, to increase its pressure by the action of heat previous to its being used in the engine, whereby greater economy is obtained in the consumption of the gas. 6, The heating and expanding of the gas for the last mentioned purpose by means of electricity. 7, The construction of a double plunger pump, which, requiring no valve, is particularly adapted for all aëriform and gaseous fluids, which require to be compressed or condensed under strong pressure, the mechanical arrangements of which are above described.

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## *Trial of Parsey's Compressed Air Locomotive.**

Mr. Parsey having completed an engine on his principle, a successful trial took place on the Eastern Counties Railway on Tuesday last. Being the first experiment, to avoid accident, and by particular request, the compressed air was worked at a low density. The small engine, adapted to the narrow gauge, started from the Stratford station, and on reaching Lea-bridge was reversed, and came back to the Stratford station, a distance of four miles. Mr. Parsey drove her himself, assisted by his son, and was accompanied on the engine by Mr. Trevethick, Mr. Ashcroft, and another officer of the company, Mr. Box, proprietor, and two others, in all eight persons. A pilot engine, with persons connected with the railway, followed the compressed air engine, to witness the trip. The effect of an engine running on the rail without heat or steam was extremely novel and imposing.

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Sir:—I am unable to give the result of further experiments to that which took place on the 25th of May, as certain arrangements for that purpose have caused an unexpected delay. In the meantime, valuable data afforded by the first trial may not be unacceptable to your readers and the proprietors of railways.

The capacity of the reservoirs is 39 cubic feet, and were charged up to 11 atmospheres = 165 lbs. per square inch. The regulator of the piston

* From the London Mining Journal, No. 875–877.

was set at starting at 20 lbs. As the engine with this limited charge of air and working pressure took 1760 revolutions of the 4-feet driving wheels in running four miles, the capacity of the cylinders being 180 cubic inches=4 cylindersful each revolution, would use 183 feet of air at some density; and as we had 429 cubic feet of atmospheric air only in the reservoirs, 183÷429, gives 2·3, or less than 1¼ atmospheres for the density of the 183 feet blown off, or about 18 lbs. per inch on the pistons. On the average, the working pressure could never have exceeded 18 lbs., as there was some power remaining on her return. The pistons being 2·5 diameter, equal to 5 inches in area, with less than 20 lbs., drove the engine and eight persons on it (2 tons besides the wheels) at the rate of eight miles per hour with the brake on, heavily pressed upon by the superincumbence of the eight persons pressing down the light springs, and crushing the brake upon the wheel, fixed on the centre of the crank shaft. This had been adjusted while the engine was free of the weight of the passengers. The consequence was an oversight, which, however, proved the power to be equal to the obstacle to starting and a fair speed.

As 400 cubic feet of atmospheric air drove the engine, &c., 4 miles, it is evident 100 feet drove her 1 mile. Now, as nothing could be said against my engine, it has been industriously circulated (before the experiment took place) that the cost of power would be prejudicial to the use of air engines. There is evidence existing that the Portable Gas Company compressed 1000 cubic feet per hour with a 10 horse power engine. It is well known that 3 lbs. of coal per horse power per hour is the outside expense of working stationary engines; consequently, as 30 lbs. compresses 1000 cubic feet, 1 ton or 2240 lbs. would compress 74,666 cubic feet of air, costing 8s. or 10s. at most; and as 100 feet drove the experimental engine 1 mile, that quantity would drive her and a carriage 746 miles for that cost.

A. Parsey.

*Oxford street, June* 10.

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## *Speed and Fares on the Great Western, and London and North Western Railways.**

It appears from a comparison of the speed and fares of the express trains upon these railways, that the speed of the fastest trains between London and Bristol on the Great Western is 43 miles per hour, and on the London and North Western, between London and Birmingham, 40 miles per hour; the difference in favor of the former company being 3 miles per hour. The speed of all the mixed trains between London and Plymouth, and London and Liverpool, is 35½ miles per hour on the Great Western, and 36½ miles on the London and North Western—being 1 mile per hour in favor of the latter. The average fares per mile on the Great Western are—for first class, 3·068*d.*, and for second class, 2·502*d.*; while on the London and North Western the average is, for first class, 2·676*d.*, and for second class, 2·178*d.*; showing a difference in favor of a passenger traveling by the London and North Western Railway of

* From the London Civil Engineer and Architect's Journal, July, 1852.

0·392*d.* for first class, and 0·324*d.* for second class. A comparison of the time occupied and fare charged on a journey of 246¾ miles on both lines, shows a difference in time in favor of the London and North Western of 34 minutes by a first class train, and of 12 minutes by a mixed train; and also at the same time a saving of 8*s.* 1*d.* for that distance by the first class, and of 6*s.* 8*d.* by the second class; the fares on the Great Western Railway for first class being 63*s.*, and for second class 50*s.* 6*d.*; while on the London and North Western the fare for the first class is 54*s.* 11*d.*, and for the second class 43*s.* 10*d.* By the mail trains, the average speed per hour is 25 miles on the Great Western, and 28 miles per hour on the London and North Western; the difference in favor of the latter being 3 miles per hour. The average fares per mile on the former railway amount to 2·724*d.* for first class, and 1·867*d.* for second class; while on the latter railway they amount to 2·419*d.* for first class, and 1·775*d.* for second class; showing a difference in favor of the latter of 0·315*d.* for first class, and 0·092*d.* for second class. A comparison of the time and fares calculated on a journey of 246¾ miles, shows a saving in favor of the London and North Western of 58 minutes, and of 6*s.* 3*d.* in first class fares, and 1*s.* 10*d.* in second class fares. By the ordinary trains, the average speed per hour on the Great Western is 25 miles, and on the London and North Western 26½ miles, being 1½ mile in favor of the latter. The saving in the first class fares being 0·583*d.*, and in second class fares 0·291*d.* per mile also in favor of the latter company. A comparison of the time occupied on a journey of 246¾ miles, shows a difference in favor of the London and North Western of 21 minutes, the time occupied by the Great Western trains being 9h. 53m.; by the London and North Western, 9h. 32m. The saving in the first class fares is 12*s.* 4*d.*, and in the second class fares, 6*s.* 1*d.* in favor of the latter company.

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For the Journal of the Franklin Institute.

## *Remarks on Incrustation in the Boilers of the Steamship Isabel.*

A few weeks since, the steamship *Isabel* came into this port for repairs of hull and machinery, and to replace her boilers. The boilers have been removed, and are now being cut up; an opportunity has thus been afforded to obtain the accompanying specimens of scale from her boilers, which in the opinion of the writer, show an extraordinary degree of ignorance or negligence on the part of those persons having charge of her machinery.

If we are not mistaken, this vessel commenced her service in the winter of 1848, and the boilers have therefore been in use three and a half years; the ship plying semi-monthly between Charleston, Havana, and Key West. She is under steam an average of sixteen days per month, for ten months in each year; consequently, the boilers are now to be replaced, after about 600 days' service. The vessel being laid up for two months in each year, for a general overhaul and repair, it is to be supposed that *at such times at least* the scale is removed; in fact, the number of laminæ in one of the pieces forwarded agrees with this supposition; therefore, this accumulation, estimated to amount to about a ton, has

been deposited in less than a year. It is commonly asserted, to exculpate careless engineers, that the water in the vicinity of coral reefs holds in suspension, in addition to the usual constituents of sea water, a quantity of carbonate and sulphate of lime. I am not aware that this assertion has been proved by an analysis of those waters; but an experience of four years on board steamships in the Gulf of Mexico, satisfies me that no accumulation of scale to exceed one-sixteenth of an inch need be made.

These boilers have common return flues, and there could have been no difficulty in cleaning them, if inadvertently in a careless moment a small deposition had been made; but unfortunately, many engineers confine their attention to the interior of the furnaces and flues, to the neglect of the interior of the boiler.

The scale averaged three-eighths of an inch thick over the shell, and upwards of half an inch on the flues and connexions; in some places not less than four inches thick; the greatest deposit in the vicinity of the back connexions, where it hung pendant like stalactites.

There can be, I think, no doubt but that this extraordinary accumulation was caused by neglecting to blow, and carrying the water at a density approaching saturation. The loss occasioned by this neglect, independent of that caused by the short term of duration of the boilers, cannot be estimated at less than fifty per cent. in fuel; and we can only attribute their exemption from collapse to the thorough manner in which they are braced, and to the fact that the engines were short of steam, and worked it off with such rapidity as to keep the pressure below the point necessary to collapse red hot flues.

Specimen No. 1. Taken from over the furnace; iron in contact with it much injured, and showing evident marks of having been overheated; half an inch in thickness.

No. 2. Taken from an angle of the furnace, at the entrance of the flues; this specimen is completely vitrified; five-eighths thick.

No. 3. Taken from the vertical portion of the shell, adjacent to the furnace; this specimen has not been in contact with red hot iron, and presents an entirely different fracture and appearance; five-eighths in thickness.

No. 4. Taken off a flue at the back connexions; presents a crystalline fracture, and marks of having been subjected to great heat; one inch and a quarter in thickness.

Note.—The specimens sent by our correspondent, are as usual, sulphate of lime, for the most part crystalized. We do not know that waters from the vicinity of coral reefs have been analyzed, but we have published in our Journal, (Vol. XIV, p. 297, 3d Series, for instance,) accounts of the formation of scale in the boilers of steamers navigating those waters, which show a very great amount of the sulphate of lime in such waters. It would seem that the scale will form very rapidly, and in fact, theory will indicate the same thing, on account of the insolubility of sulphate of lime in hot water. Blowing at short intervals of time appears to be unavailable to prevent the formation of scale, but certainly these facts will not justify the formation of stalactites. Every one who sees the specimens now sent, will at once admit that they indicate very gross negligence on the part of those in charge. Editor.

# AMERICAN PATENTS.

*List of American Patents which issued from Aug. 10th to Sept. 7th, 1852, (inclusive,) with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

15. For an *Improvement in Processes for Making Illuminating Gas;* Henry W. Adams, City of New York, August 10.

*Claim.*—"What I claim as my invention is, the process of manufacturing illuminating gas, substantially as herein set forth, the process of feeding into heated retorts charged with bituminous coal, either oil, coal tar, resin, or asphaltum, or any other bituminous or carbonaceous substances, separately or mixed, and reduced to a fluid state, and decomposing the same in the same retort, and by the use of the same heat, in conjunction with the distillation of the coal, in the manner and for the purposes substantially as herein described."

16. For *Improvements in Double Gates;* J. S. Brown, Washington, D. C., August 10.

*Claim.*—"What I claim as my invention is, the arrangement of the forked rods, or their equivalents, in combination with the inclined track and roller, for the purpose of causing the gate always to swing in the direction from the rider, substantially as herein set forth.

"I also claim the combination of the latch, catch, and pin, or their equivalents, substantially in the manner and for the purpose herein set forth."

17. For an *Improvement in Casting Type;* William P. Barr, Assignor to George Bruce, City of New York, August 10.

*Claim.*—"What I claim as my invention is, the employment in type casting machines of an adjustable valve, substantially in the manner described."

18. For an *Improvement in Cider Mills;* Jarvis Case, Selma, Ohio, August 10.

*Claim.*—"Having fully described the nature and operation of my invention, what I claim as new is, the employment of the revolving crushing cylinder or roller, with grooves cut in its periphery, the movable feeding slats or radial cogs, the eccentric rings or plates, and the scrapers, the whole being constructed, arranged, and operating in the manner substantially as and for the purpose herein set forth."

19. For an *Improvement in Machines for Drilling Stones;* Henry W. Catlin, Administrator of the Estate of Alexander Catlin, deceased, Burlington, Vermont, August 10.

"This machine is intended for boring or drilling stone, by the rotation of a wheel or radial arms, furnished with revolving cutters, which grind or pulverize the stone with which they are placed in contact."

*Claim.*—"In behalf of the within named Alexander Catlin, I claim the revolving arms or wheel, having a cavity near its centre, to receive the core of the stone, in combination with the revolving cutters, in the manner and for the purpose herein described."

20. For an *Improvement in the Method of Securing Movable Points of Railroad Frogs;* Marshall Curtis and Edgar St. John, Binghampton, New York, August 10.

*Claim.*—"What we claim as new in our invention is, the combination of the peculiarly formed shank of the frog point and its corresponding channel and socket; said point secured to its seat by spike and bolts, or their equivalents, substantially as described."

21. For an *Improvement in Tanning;* A. K. Eaton, Rochester, New York, August 10.

"My invention consists of a combination, with my tanning liquor, of certain substances which have the effect of facilitating its action; also of preventing the extraction or other matter of the bark or substance from which the tannin is obtained, from acting injuriously upon the leather."

*Claim.*—"Having thus described my process of tanning leather, what I claim as my invention is, the combination of sulphate of potash with the tanning liquor, substantially in the manner and for the purposes herein set forth."

22. For an *Improvement in Grain and Grass Harvesters;* Daniel Fitzgerald and John H. Smith, City of New York, August 10.

"The nature of this invention is the adaptation of the common grain cradle to machinery. The apparatus consists of a cart, (the two wheels of which are the motors of the machinery,) and the cradling apparatus attached."

*Claim.*—"What we claim as our invention is, 1st, The construction of the floor in the centre, upon which a man may stand to gather the grain.

"2d, The construction the rim, to which the knives are attached, for the purpose of giving the buts of the grain a bed to stand upon, while being carried through the channel to the centre.

"3d, The constructing a spiral channel within the guards, for the purpose of gathering the grain within the central space."

23. For an *Improvement in Carriages;* Jonathan Fox, Manchester, New Jersey, August 10.

*Claim.*—"What I claim as my invention is, 1st, Making the hubs of wheels of two disks of wood, with angular scores cut in them, to which the spokes are fitted, so that as the disks are drawn together, they bind the sides as well as the edges of the spokes; said disks of wood being fitted to and confined between two plates of metal, substantially as described.

"2d, The sliding perch, in combination with the levers, ratchet wheel, and pawls, or such analogous devices equivalent to these as will raise the hind end of the body of the carriage and load, when the hind axle stops, while the fore one moves forward; the weight of the hind end of the body and load aiding, as it descends, in propelling the hind axle forward; the body being made to slide upon the rocker of the forward axle as described, or otherwise.

"3d, The sliding perch, in combination with the levers, or such analogous devices equivalent thereto as will raise the load, or a part of it, when the team or moving power starts, so as to partially relieve the team and carriage from the sudden jerk and shock to which it is subject when the connexion is firm and unyielding."

24. For an *Improvement in the Manufacture of Glass Lenses;* John L. Gilliland, City of New York, August 10.

*Claim.*—"What I claim as my invention is, the manufacture of dioptric lenses of glass in steps or rings, by pressure in metallic moulds, substantially as specified."

25. For an *Improvement in Method of Converting Reciprocating into Rotary Motion;* Charles Howard, Alton, Illinois, August 10.

*Claim.*—"What I claim as my invention is, an apparatus, substantially such as is herein described, for converting a reciprocating motion into a rotary one, or converting a rotary into a reciprocating motion, consisting of the wheel, levers, and connecting rods, or their equivalents, for the purposes specified."

26. For an *Improvement in Mode of Drying Sized Paper;* John Kingsland, Jr., Saugerties, New York, and Norman White, City of New York, August 10.

*Claim.*—"Having fully described our invention, what we claim therein as new is, the process of drying sized paper, by passing it between a series of trunks, perforated on two sides, and so arranged, that the hot air passing through these perforations will come in contact with both sides of the paper, and then escape, and not run or be confined with the sheets."

27. For an *Improvement in Reducing Gold Mineral;* William Longmaid, Beaumont Square, England, August 10, 1852; patented in England, January 29, 1852.

*Claim.*—"I do not claim the use of lime when forming fluxes; but what I claim is, the use of iron, substantially as described, to extract portions of gold, when the same are not readily precipitated by their density."

28. For an *Improvement in Looms for Weaving Pile Fabrics;* Samuel Richardson, Claremont, New Hampshire, August 10.

"These improvements relate chiefly to the peculiar construction and to the mode of operating the pincers, which draw out and insert the wires which are placed between the ground and pile warps, for the purpose of raising the loops which form the pile."

*Claim.*—"What I claim as my invention is, the spring flaps, or their equivalents, which open and close the pincers upon the wires, and support the wires after they are drawn

from the loops and carried to a proper position, to be inserted between the sheds of warp and guiding them into the same, substantially as described."

29. For an *Improvement in Railroad Car Brakes;* John Schoenherr, Reading, Pennsylvania, August 10.

*Claim.*—"Having fully described and represented the nature and operation of my improved mode of rendering railroad car brakes inoperative at the pleasure of the engineer, or man in the locomotive tender, and thus dispensing with a corps of brakemen, what I claim therein as new is, the method of arranging and operating the parts which render the brakes inoperative, at the pleasure of the engineer or other hand, viz: hanging the drops, *a*, from arms, *v*, on arbors, *t*, with arms, *s*, projecting in a contrary direction to the arms, *v*, the arms, *s*, being connected by links, *q* and *r*, midway to a lever, *k*, the end, *l*, of which is the fulcrum; the power being applied to the other end, through the eye, *m*, by means of the rope, *n*, which passes through loops, *o*, along the entire train, to the rear end of which it is made fast; the same devices being repeated, and capable of instantaneous action on each car; the arrangement thus having nothing in itself antagonistic to the end in view, the rope, *n*, being always slack, and by its own weight and motion, when the train is under way, keeping the drops, *a*, up and out of the way of the brakes, so that the brakes are always operative, unless the engineer, by winding up the rope, *n*, throws down the drops, *a*, and renders the brakes inoperative for the time being; the whole being substantially as described and represented: by no means intending to claim, however, the interruption of the operation of the brakes, actuated by the crowding of the cars upon the locomotive, by the interposition of drops, when these are interposed by mechanism, the weight and motion of which, when the train is under way, is antagonistic to the counterbalance intended to keep the drops up and out of the way of the brakes."

30. For an *Improvement in Hats;* Benjamin Sherwood, County of New York, August 10.

*Claim.*—"What I claim as my invention is, 1st, The attaching to a hat a ring, or part or parts of a ring, inside, to fit upon the head, and leave a space around it, for the purpose of producing ventilation, in the manner substantially as described.

"Second, I claim constructing a band, for the purpose of fitting easily to the head, of thin metal, made flexible by cutting out part of the substance, in the manner substantially as above described in the strip, fig. 4."

31. For *Machinery for Threading Wood Screws;* Cullen Whipple, Providence, Rhode Island, August 10.

"My invention and improvement consists of a rotating concave annular burr cutter, for threading screw blanks, and of a combination of the foregoing with suitable rests and turn screws, for presenting the blank to the cutter, and rotating it while being threaded; likewise, of a combination of a vibrating rest to support the screw blank, and a rotating turn screw vibrating with the rest, to turn the blank."

*Claim.*—"What I claim as my invention is, 1st, An annular concave burr cutter for threading screws, having a helical or conical serrated thread, substantially as described.

"2d, The combination of the moving rests on opposite sides of a revolving screw cutter, with the mechanism herein described, or the equivalent thereof, for operating the same in such manner as to move them simultaneously towards and from the cutter, to press the blanks against the latter to be threaded, and so that the pressure of one blank in one direction may be counteracted by the pressure of another blank in the opposite direction, as set forth.

"3d, The combination of the vibrating rests with the vibrating rotating turn screws, substantially in the manner herein described, so that the blank may be rotated steadily and with regularity, while the rest is carrying it towards the cutter, to sink a screw thread on it."

32. For an *Improvement in Mill Dress;* John W. Kane, New Carlisle, Ohio, August 10.

*Claim.*—"I do not claim a circular mill-stone dress, in which the furrows are arcs of circles swept from a single centre; but what I do claim is, the particular mill dress represented in fig. 1, and laid down by the pattern shown in fig. 2, constructed and arranged as described, or in any manner substantially the same."

33. For an *Improvement in Ventilators;* Mortimer M. Camp, New Haven, Connecticut, August 17.

*Claim.*—"I do not claim the upper cylinder, the flanches attached thereto, the lower

cylinder, nor either set of the wings upon a vertical shaft therein; but what I do claim as new is, the two cones arranged and combined with a ventilator, composed of revolving vanes and flanches and cylinders, operating as above described and set forth."

34. For *Improvements in File Cutting Machinery;* John W. Conklin, Henry L. Sidman, and Eugene Wintner, Ramapo, New York, August 17.

*Claim.*—"Having described our improvements in machinery for cutting files, what we claim as our invention is, as herein constructed and combined, the racks, pinions, cams, or eccentrics, rods, and springs, in connexion with the vibrating hammer, as described, for the graduation of the blow, at the commencement of the operation."

35. For a *Machine for Making Wrought Iron Railroad Chairs;* Robert Griffiths, Newport, Kentucky, August 17.

"The nature of my invention consists, 1st, in a combination of devices, whereby my machine is rendered capable of adjustment, for cutting and turning the clips of a wrought iron railroad chair, of varied forms and of any required size, to fit the various sizes and patterns of rails in use.

"2d, In so forming and operating the cutting edges, that they shall shear the plate in such lines, that when cut, it shall be perfectly free from the dies, and not remain in contact with them, to draw the temper, and render them incapable of making a smooth cut, as is the case with other machines heretofore used for this purpose."

*Claim.*—"Having thus described my invention, what I claim therein as new is, 1st, the arrangement and combination of the feathered wedge and dies, as described, for filling the cavity between and fitting around the knuckle end of the shears and benders, forming an adjustable, solid, and level bed for the centre of the plate, whilst being cut and bent, and preventing the fulcra of the shears and benders from moving towards the centre, away from the set screws.

"Secondly, I claim furnishing the caps of the pedestals with adjustable cutters, the cutting edges of which are nearer to each other at the outer than at the inner end, and which shear the plate, in conjunction with the cutters on the face of the shears, which are narrower at their outer than their inner end, in order to cut the clip of the chair narrowest at the point, and thereby leave it perfectly free and clear of the cutters in the cap, so that the cap will lift free from the plate."

36. For *Improvements in Spark Arresters;* Joseph Leeds, George H. Oat, Jr., and Alfred A. Oat, Assignors to Joseph Leeds, Philadelphia, Pennsylvania, August 17.

"The nature of our invention consists in surrounding the spark chamber, or that part which usually constitutes the outside of the stack, with a draft flue, which has openings below, flared or otherwise, to take in the air, and which extends up above the top of the inner chimney, and may be covered by a cap, or otherwise; said draft flue being for the purpose of aiding the draft of the chimney, which becomes impeded by the separation of the sparks from the other products of combustion."

*Claim.*—"Having thus fully described our invention, what we claim therein as new is, combining with a stack or chimney, provided with chambers and openings for separating and passing out the smoke and gases, and retaining the sparks, substantially such as herein described, the draft flue around the stack which takes in air at the bottom, and furnishes at the top of the chimney additional draft to supply that impeded by the separation of the sparks; the whole being arranged substantially as herein set forth."

37. For an *Improvement in Cotton Presses;* Lewis Lewis, Vicksburg, Mississippi, August 17.

*Claim.*—"Having fully described the nature and operation of my press, what I claim therein as of my invention is, the arrangement of the press herein above described, in such manner that it may be conveniently charged in an upper story of the building in which it is placed, and actuated and discharged in a lower story of the same, substantially as herein set forth, reference being had in my claims for Letters Patent, to the drawings and specifications as filed and herein before set forth."

38. For an *Improvement in Hernia Truss;* Allen I. Lownsberry, Sommerville, Tennessee, August 17.

"The principal feature of this invention, and upon which its utility and excellence mainly depend, consists in the peculiar form of the front plate, or pubic brace, and its combination, as a strong support to the bowels and abdomen, with the curative action of

the balls upon the track of the inguinal canal, and its peculiar connexion with the other parts of the apparatus."

*Claim.*—"What I claim as my invention is, the peculiar shape of the two balls, and their arrangement upon the slides, so that they may be moved upward and downward, and right and left, to any part of the metallic plate on the pubic brace, and thus be fitted to any rupture in the abdominal rings, or on any sized person, and their combination with the pubic brace, as above described."

39. For an *Improvement in Artificial Legs;* B. Frank. Palmer, Philadelphia, Pennsylvania, August 17.

*Claim.*—"I am aware that the tendo achilles has been extended upward and attached to the thigh piece, for the purpose of drawing upward the heel, and depressing the forward part of the foot, when the leg is straightened; and therefore I do not claim that arrangement as my invention. But what I do claim as new is, attaching the upper end of the tendo achilles to a lever, or to its equivalent mover, which is united to an auxiliary tendon, that descends from its connexion with the thigh piece; and also the so arranging of the said lever and tendons that when the weight of the person is thrown upon the ball of the foot, in walking, the powerful downward strain, which will thereby be exerted upon the tendo achilles, will exert little or no influence upon the said auxiliary tendon, (which descends from the thigh piece,) or at any rate, no influence that will have an appreciable tendency to bend the knee, or give instability thereto, substantially as herein set forth."

"I also claim the vibrating brace and elastic cord, operating in combination, substantially in the manner and for the purposes herein set forth."

40. For an *Improvement in the Neck Yoke of Horses;* Calvin L. Rawdon, Bristol, Ohio, August 17.

*Claim.*—"What I claim as my improvement is, the spiral springs, operated by the rods giving extension and contraction to the yoke, in the manner and for the purpose herein set forth."

41. For an *Improvement in Artificial Legs;* Jonathan Russell, Philadelphia, Pennsylvania, August 17.

"The nature of my invention is so combining and arranging the several parts of an artificial leg, as that the knee joint shall be firmly locked by the weight upon it, when applied to either the toe or heel part of the foot, thus making the knee joint perfectly rigid, when the leg is erect, and the weight of the body or a portion of it is thrown upon it, at the will of the wearer."

*Claim.*—"Having thus fully described my invention, what I claim therein as new is, so operating the lever through the spring, by means of the cords, which are respectively attached to and operated by the toe and heel part of the foot, as that when the leg is bent forward or back on the ankle joint, the knee joint shall be locked by said lever, substantially as described."

42. For an *Improvement in Bedstead Fastenings;* William Shaw, Clarion, Pennsylvania, August 17.

*Claim.*—"What I claim as my invention is, the plug as above described, in combination with the clamp or clamps, for fastening bedsteads."

43. For an *Improvement in Hot Air Furnaces;* George S. G. Spence, Boston, Massachusetts, August 17.

*Claim.*—"Now I do not claim a descending draft as such, or an alternately descending and ascending draft; nor do I claim a draft divided and carried in different directions through several pipes or columns at a time; nor do I claim one undivided draft, carried through several pipes and columns at a time: but what I do claim as my invention is, the combination and arrangement of the ash or soot separate chambers and the flues, from whose external surfaces the heat is radiated into the air chamber of the hot air furnace; that is to say, I claim the combination and arrangement of the descending flue at and down the back of the fire place, the ash flue chamber, the ascending and descending arched pipe, the ash flue chamber, the ascending and descending arched pipe, the ash flue chamber, and the vertical flue discharge pipe, carried up against the back of the fire place, and having a communication with the fire place and a damper; all substantially as specified."

44. For an *Improvement in Machinery for Forming Hat Bodies;* Thomas Walber, City of New York, August 17.

*Claim.*—"Having described the construction and operation of the parts, I wish it to be

distinctly understood that the apparatus for picking and separating the fur forms no part of my invention, neither does the movable trunk, all these parts being well known and in ordinary use in cotton pickers and gins; neither do I claim retaining the fibre on the former by exhaustion by a blower, that being public property, having been shown in a patent issued to T. R. Williams, in England, in 1833; neither do I claim the use of water, to form the packing for the cylinder, that having been used in other machinery, and hot and cold water have been used in felting cloth and hat bodies; therefore, this forms no part of my claims.

"I do not limit myself to the screw, to raise and lower the former and trunk, as a rack and pinion or similar means may be used. But what I claim is, 1st, The combination of the water packed cylinder, former, and sliding and revolving shaft, for the purposes and as described.

2d, I claim giving alternate motion to the former and blower case, so that one is raised while the other is lowered, in the manner and for the purposes described.

"3d, I claim the hood, with its lining, by which steam or other gaseous pressure is made to force the bag or lining, on to the bat or former, in combination with the standing perforated pipe, or its equivalent, by which the bat is wetted through the perforations in the former, as described and shown."

45. For an *Improvement in Coloriferes;* Samuel Whitmarsh, Northampton, Massachusetts, August 17.

*Claim.*—"What I claim as my invention is, the combination of the water supply reservoir, the chamber or bed of sand, and a furnace or chamber of combustion; the whole being made to operate substantially as specified."

46. For an *Improvement in the Curriers' Beam and Knife;* James D. Willoughby, Carlisle, Pennsylvania, August 17.

*Claim.*—"What I claim as my invention is, the construction of a curriers' beam, with flaps on its edges furnished with springs and gauges, or their equivalents, for the purpose of dispensing with the kneeing, and prevention of cutting through, and production of regular thickness of leather.

"I also claim the construction of a knife, made adjustable by the eccentric handle or its equivalent, in connexion with the gauges or guides, substantially as and for the purpose set forth in the foregoing specification and accompanying drawings."

47. For an *Improvement in Processes for Making Paints;* Washington F. Davis, Assignor to Birdsill Cornell, City of New York, August 17.

*Claim.*—"I am aware that various mixtures of gelatine, albumen, gums, and gum resins have been used in watery solutions, for making a cheap paint that cover extensive surfaces; but such paints as the gums dry, crack, and leave fissures in the surfaces so covered, and have other defects; I do not, therefore, claim of use of watery solutions with such materials: but what I claim as my invention is, the use of a watery solution of the sulphate of zinc, to be mixed with white lead, zinc white, or other oil paints, in the manner herein set forth."

48. For an *Improved Fastener of Bits to Braces;* Erasmus Smith, Assignor to David Maydole, Norwich, New York, August 17.

*Claim.*—"Having described my improved hand drill or brace, what I claim as new therein is, the combination of the cam lever with the lever spring-catch, for securing the bit in the socket, and releasing it therefrom; the same being constructed, arranged, and operating substantially as described."

49. For an *Improvement in Manufacturing Cord Buttons;* Nelson Perkins, Wawarsing, New York, Assignor to Samuel Dow, Westfield, Massachusetts, August 17.

*Claim.*—"What I claim as my invention is, the preparation of the cords, in the process of manufacturing cord buttons, by gluing them together, substantially in the manner and for the purpose herein set forth."

50. For an *Improvement in Bill Registers;* J. N. Ayres, Stamford, Connecticut, August 24.

"The principal object of this invention is to show at a glance, to those persons in a counting house or other place of business, whose duty or wish it is to know, what bills are becoming payable or receivable every month, and their dates and amounts."

*Claim.*—"Having thus described my invention, I will now proceed to state what I claim:

"In combination with the perpetual calender in the same table, frame, or box, I claim the bill register, consisting of the strips or sheets of paper, or other material, suitably ruled for names and amounts, and inserted in or attached to the table, frame, or box, in any convenient way, so as to be easily removable or renewable, on either side of the columns of days of the month and week, under suitable headings, which denote whether the bills are payable or receivable, as herein substantially set forth."

51. For an *Improvement in Cooking Stoves;* Reuben J. Blanchard, Albany, New York, August 24.

"My improvement consists in introducing into the front and back flues, a separator, to divide the columns of heated gases, during a portion of their descent and ascent in these flues."

*Claim.*—"What I claim as my invention is, the placing the separators in the front and back descending and ascending flues of a cooking stove, to divide the products of combustion, while they are permitted to pass undivided over the top and under the bottom plates of the oven, substantially as described in the above specification."

52. For an *Improvement in Instruments for Lasting Boots;* Hezekiah Conant, Worcester, Massachusetts, August 24.

*Claim.*—"What I claim as of my invention is, the combination of the two levers, connected together and connected to the jaws, also connected to the step, by which combination, on opening the pincers, the simultaneous motion of the two jaws are guided, so as to take hold of both sides of the leather, and by pressing the handles towards each other, bring up the leather with equal tension on both sides. I claim this for the purpose and in form, substantially as above described."

53. For an *Improved Machine for Cutting Cheese;* Walter K. Foster, Bangor, Maine, August 24.

*Claim.*—"I do not claim the mere combination of a disk and spindle; but what I do claim as my invention is, the combination of the groove and the slot with the spindle and its sustaining board, so as to guide the point of the knife, and support the pointed end of the knife, when the knife is forced down through the cheese, as stated.

"And in combination with the groove, slot, and plate or board, I claim the secondary rotary board, to be applied and used substantially in manner and for the purpose as specified."

54. For an *Improvement in a Bed for Invalids;* Stevens D. Hopkins, Staunton, Virginia, August 24.

"The nature of my invention consists in arranging a frame, upon or within which any ordinary bedstead may stand, with a sheet, hammock, or mattress suspended from a carriage on top of said frame, so that it may be raised up or rest upon the bed, as the case may be, or removed from over the bed and used as a swing, for gently exercising or for removing the patient from one bed to another, without lifting, as is usually done."

*Claim.*—"Having thus fully described the nature of my invention, what I claim therein as new is, suspending the sheet, hammock, or mattress, upon which the patient lies, to a carriage, which moves on a frame placed over or around a common bed, so that by said carriage the patient may be raised up or let down upon the bed, or moved from one place to another, or gently exercised; the whole being arranged, combined, and operating substantially in the manner described and fully shown."

55. For an *Improvement in Instruments for Lasting Boots;* Benjamin Livermore, Hartland, Vermont, August 24.

*Claim.*—"I do not claim as my invention the screw, the standard, the nut, or the arms; but what I do claim as my invention is, the mode of bringing the arms together, by the means of the slots in the arms, and the bolt operating in the slots, when this is used in combination with the standard, substantially in the manner herein described."

56. For an *Improvement in Signal Telegraphs;* Charles Latimer, Washington, District of Columbia, August 24.

"The nature of my invention consists in the arrangement of colored and white lights, one above the other, into cornets and numbers."

*Claim.*—"What I claim as my invention is, the formation of a complete system of telegraphic signals, by means of a vertical arrangement of white and colored lights, or their equivalents, by which any number and species of signals may be made with ease and simplicity."

57. For an *Improvement in Churns;* Rufus Maxwell, Lewis County, Virginia, August 24.

*Claim.*—"I claim, 1st, the forcing of the milk through a rack, by revolving the churn in an orbit, without turning it on its axis.

"2d, The bow and rods connected together, as above described."

58. For an *Improved Abutment Motion for Reversible Rotary Engines;* Cassius A. Mills, Coldwater, Michigan, August 24.

*Claim.*—"What I claim as my invention is, the combination, for the purpose of withdrawing the sliding heads at proper intervals and returning them, whichever way the engine is working, of the rods, the levers, the wheels, with their wedge-shaped projections or inclines, and the springs; the whole arranged and operating in any way substantially as set forth."

59. For an *Improvement in Machines for Cutting Hand Rails;* George B. Pullinger, Philadelphia, Pennsylvania, August 24.

*Claim.*—"What I claim as my invention is, arranging the rollers, one above the other, within a revolving frame, so as to allow the curved roller, or its equivalent, being substituted for the roller at the time desired, and in the manner and for the purpose herein fully specified."

60. For an *Improvement in Horse Power;* David Russell, St. Louis, Missouri, August 24.

"My improvement consists of a novel method of employing the power of horses, by which their weight as well as draft is rendered available, and by which the velocity of the running parts is not reduced, by extending the circle or sweep upon which the friction wheel travels."

*Claim.*—"Having thus fully described my improved horse power, what I claim therein as new is, 1st, the combination of the canting tread wheel, the horizontal sweep shaft, and friction wheel, for producing motion, in the manner described, by which the wheel is always running down hill, by throwing the weight of the horse on to the canting wheels, just forward of it, as above described."

61. For *Improvements in Mechanism for Griping Wood Screw Blanks, &c.;* Thomas J. Sloan, City of New York, August 24.

*Claim.*—"What I claim as my invention for operating the griping jaws on the mandrels of machines for threading or shaving the heads of wood screws, is, the employment of a wedge on a stem within the mandrel, to act on the jaws, to close them, substantially as specified, when the said wedge stem is combined with a sliding frame, or its equivalent, by means of an interposed spring, substantially as specified, for the purpose of adapting the jaws to the griping of blanks of various sizes, as set forth.

"And I also claim, in combination with the said spring connexion, for the purpose specified, the making of the wedge faces curved, substantially as specified, to insure an equal or nearly equal force on the griping jaws, as set forth."

62. For an *Improvement in Threading Pointed Wood Screws;* Thomas J. Sloan, City of New York, August 24.

*Claim.*—"What I claim as my invention is, giving to the mould or former, or its equivalent, motion, substantially as specified, whereby the cutting away of the metal at the end of the shank is divided amongst several threading motions, instead of being cut away at the first threading motion, as heretofore practised."

63. For an *Improvement in Railroad Truck;* Edwin Stanley, Bennington, New York, August 24.

*Claim.*—"I claim as my invention, 1st, the combination of the brake with the wheel and rail, arranged and operating substantially as described.

"2d, Making the wheel substantially as herein described, for the purposes of preventing from clogging with snow, or other substances, and giving it a better hold upon the rail, as above suggested."

64. For an *Improvement in Apparatus for Feeding Boilers;* Andrew Walker, Jr. Johnsbury, Vermont, August 24.

*Claim.*—"What I claim as my invention is, the combination of the heater or vessel and its pipes and stop cocks, or either of them, with the tank, boiler, and force pump, so as to operate therewith, or enable the force pump to be operated, substantially in manner and under the circumstances as above set forth."

65. For an *Improvement in Mills for Mashing Vegetables and Mixing Clay;* Clark Alvord, Geddes, New York, August 31.

*Claim.*—"What I claim as my invention is, the use of grated hollow cylinders, operating together, so that the grates of one cylinder must be between the grates of another cylinder of like construction, thereby forcing the material operated upon from the periphery of the cylinder or cylinders to the inside of such cylinder or cylinders, thereby mashing, grinding, and mixing the same, as above set forth."

66. For an *Improved Reverberatory Furnace;* Christopher G. Best, Albany, New York, August 31.

*Claim.*—"I claim the reverberatory furnace, constructed as described; the fuel with the fire box being above the metals to be melted in the chamber, and bringing the flame and heated products of combustion vertically down through the metals in the chamber, in the manner and for the purposes set forth."

67. For an *Improvement in Wash Boards;* Lester Butler, Kenoshu, Wisconsin, August 31.

*Claim.*—"What I claim is, the curved or circular form of the crimp, giving a better chance for the suds and water to remain amid the clothes during the process of rubbing, and also keeping the water near the centre of said board; thus rendering the work easier than the old fashioned form."

68. For a *Roller Saw-Set;* Abel Bradway and Elijah Valentine, Monson, Massachusetts, August 31.

*Claim.*—"Having fully described our improved saw-set, what we claim therein as new is, the stamps alternating with the spaces upon the end of a cylinder, in combination with a beveled cylinder, which is caused to revolve with equal velocity in the direction opposite to that of the cylinder, arranged in the manner and for the purpose substantially as herein described."

69. For an *Improvement in Kilns for Pottery;* George R. Booth, Hanley, England, August 31; patented in England, June 15, 1843.

*Claim.*—"What I claim as my invention is, the arrangement of the fire hearth below the oven bottom, and provided with suitable apertures for the admission of air, to regulate the combustion, substantially as described, when this is combined with the oven or heating chamber, provided with a tube, or the equivalent thereof, as specified, for discharging the heat above the bottom of the oven, and diffusing it in the oven, and also provided with outlet flues or apertures at or near the bottom, and with apertures or tubes at or near the top of the discharge of gases or steam, all substantially as herein described and for the purpose specified."

70. For an *Improved Blind Operator and Fastener;* James R. Creighton, Cincinnati, Ohio, August 31.

"My improvements consist in a method of opening, closing, and fastening window blinds from the inside, by machinery which passes from the inside, under the stool and through the subsill; the motion of the blind being accomplished by a straight shove out or pull in, as the case may be, such a motion only requiring a straight mortise through the subsill."

*Claim.*—"Having thus described the nature of my improvement in blind operators, what I claim therein as new is, the combination and arrangement of the sliding plate, provided with a notch and extension rod and handle, with the vibrating link and fastening, and with the catch and notches, by which I am enabled to operate a blind from the inside, by a straight shove or pull, as the case may be, and to fasten it shut or partially open, as required."

71. For an *Improvement in Artificial Legs;* John S. Drake, City of New York, August 31.

*Claim.*—"I do not claim the use of a spring to throw the lower part of the leg forward, but I am not aware of any straight or curved spring having been used with a skeleton knee, as herein shown. I do not claim the open skeleton, to receive the stump, as the ordinary wooden legs have been secured by straps and bands, acting in the same manner and for the same purpose.

"What I claim is, 1st, the skeleton knee piece, in combination with the spring, attached at its ends to the upper and lower parts of the leg, as described and shown.

"2d, I claim the arrangement of the spring toes on their centre, kept down by the spring, as described and shown.

"3d, I claim the locking piece and hook, to allow of the bending of the leg, as described and shown."

72. For an *Improvement in Oil Cans;* Samuel Field and Charles W. Heald, Barre, Massachusetts, August 31.

*Claim.*—"What we claim as our invention is, the combination of the receiving chamber, D′, with the chamber, D, and flanch, L; the whole being constructed, and arranged, and operating in manner and for the purpose substantially as herein set forth and specified."

73. For *Improvements in Printing Press;* George P. Gordon, City of New York, August 31.

*Claim.*—"Having fully described and explained my improvements, I do not claim the periphery of a cylinder as a distributing surface for the ink, nor the segment of the cylinder, to form a place for the form of type, so arranged by catches and stops that it may be turned over any distance, to receive the form, as in the Voorhies press; but what I do claim is, the arrangement and application of a cylinder which always remains stationary in its own position, as well while receiving the form as when used as a distributing surface.

"I do not claim an arm or single frame, to carry one set of rollers around the periphery of a cylinder, as in the Voorhies press; but I do claim the combination and arrangement of several sets of rollers in one frame, to traverse round the periphery of a cylinder, when these sets of rollers alternately or consecutively pass over the form, and admit an impression to be taken, between the time one of the sets leaves the form and the next set arrives to it, for the purpose of giving slow motions to the inking, with rapid impressions upon the same form; thus effecting more speed, as regards the amount or number of impressions to be produced in a given time.

"I do not claim the continuous sheet, nor feeding a continuous sheet of paper to a printing press; but I do claim the arrangement of the gauge, 1, guides, 2, pawl, *r*, cranks, *s* and *d′*, rod, E′, pin, *f*, and wheels, *a′*, in combination with the shears for cutting off the sheet after it is printed, and the cam, *y*, from which it receives its motion; the whole of these parts operating as described; all of which is herein fully described and set forth."

74. For an *Improvement in Washing Machines;* Jarvis T. Mudge, Washington, District of Columbia, August 31.

*Claim.*—"Having described my improvement, what I claim as my invention is, the providing a washing machine with a hinged flap rubbing board, or its equivalent, for turning the clothes in the tub, in combination with the dasher and hinged presser, for the purposes set forth and shown in the specification and accompanying drawings."

75. For an *Improvement in Governor for Steam Engines;* George S. Stearns and Wm. Hodgson, Cincinnati, Ohio, August 31.

*Claim.*—"What we claim as new is, the combination of the quadrants and the cylindrical rack, arranged and operating substantially as set forth; not confining ourselves to the cylindrical form of the rack; other forms may be used, if found to suit, such as square, or any polygon form."

76. For a *Process for Restoring Shape and Tempering Articles of Hardened Steel;* John Silvester, West Bromwich, England, August 31; patented in England, July 17, 1850.

*Claim.*—"And having now described my said invention, and the manner in which the same is to be performed, I declare that what I claim is, the curing or remedying the distortion which has taken place in steel plates during the operation of hardening, by com-

pressing them between dies, previously heated to a sufficient degree to "bring back" or "let down" the temper; the mechanical pressure to be applied while the plates are in the course of being tempered, (the pressure being continued during the process of tempering,) as before exemplified and described."

77. For an *Improvement in Brick Machines;* Arad Woodworth, 3d, and Samuel Mower, Boston, Massachusetts, August 31; patented in England, January 24, 1852.

*Claim.*—"Having described our improvements, what we claim as of our invention is combining with the percussion machinery, the lower piston or pistons and machinery, to produce a compression of the bottom surface of the brick, and machinery to produce a compression of the top surface of the brick; the whole being substantially as herein before described; not meaning such compression of the same as is produced by the percussion of the ram, but a separate compression, effected by other means, as described.

"We also claim the improvement of constructing each of the orifices of the mould charger with flaring or inclined sides, inclining inwards towards each other as they descend; the whole being substantially in manner, and to effect the object or overcome the difficulty, herein before stated.

"We also claim the improvement of combining with the adjustable gate, or striker, a mechanism that will cause it to rise upwards as the mould charger moves forwards towards the moulds; such rising upwards of the striker being for the purpose herein before explained."

78. For an *Improved Metallic Stuffing-Box Packing in Steam Engines;* Ebenezer Winship, City of New York, August 31.

*Claim.*—"Having fully described my invention, what I claim therein as new is, the combination of an elastic ring, made to fit tightly on the rod and loosely in the stuffing box, and having an intercepting tongue and spring plate, to prevent the steam from escaping through the slot therein, with the plate, or its equivalent, fitting tightly over the ring, and loosely encircling the rod, and the gasket, or its equivalent, above said plate, substantially as described."

79. For an *Improvement in Electro-Magnetic Fire Alarms;* Henry Van Ansdall, Preble County, Ohio, August 31.

*Claim.*—"I claim the combination and arrangement of a signal wheel with two elastic circuits, so that when one is broken the wheel may revolve, and operate a key in the other circuit.

"2d, I also claim the mode of constructing an elastic circuit, by breaking, tapping, and binding with a combustible material, or equivalent, for the purpose of making it sensitive to fire, as herein described."

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### Re-issues for August, 1852.

1. For an *Improvement in the Manufacture of Bullets, &c.;* George W. Campbell, City of New York, dated November 20, 1847; re-issued August 3, 1852.

*Claim.*—"I do not therefore claim as of my invention, casting bullets, buckles, and other articles, in a series of moulds moving under a spout, when the surface on which the lead is poured is unbroken; nor do I wish to limit myself to the precise construction of moulds, nor to the special arrangement of them, so long as the same results are produced by equivalent means. But what I claim as my invention in the method of casting bullets, &c., in a succession of connected moulds, is, jointing them together, so that they shall separate and come together in vertical planes, at right angles to the line of motion of the series, or nearly so, substantially as and for the purpose specified."

2. For an *Improvement in Making Lamp Black;* John G. Muir, Philadelphia, Pennsylvania, dated November 13, 1844; re-issued August 24, 1852.

*Claim.*—"What I claim as my invention and improvement is, the mode herein described of burning lamp black, that is to say, burning it in a confined building or room, without chimney or draft, substantially in the manner set forth in the above specification."

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### Designs for August, 1852.

1. For a *Design for a Cooking Stove;* Samuel Eberly, Mechanicsburg, Pennsylvania, August 3.

*Claim.*—"What I claim as new is, the combination of the ornaments with the panels raised on the surface of the side plate of the stove."

2. For a *Design for a Water Cooler;* Patrick Molony, Cincinnati, Ohio, August 3.

*Claim.*—"What I claim as my production is, the design and configuration of an ornamental water cooler, substantially as described and represented in the annexed drawings."

3. For a *Design for a Cooking Stove;* Russell Wheeler and Stephen A. Bailey, Utica, New York, August 3.

*Claim.*—"We do not claim the exclusive right to the general construction of the stove; but what we do claim is, the design and configuration of the ornaments and mouldings, as described and set forth in the accompanying drawings."

4. For a *Design for a Cooking Stove;* Garretson Smith, Henry Brown, and Julius Holzer, Assignors to North, Harrison, and Chase, Philadelphia, Pennsylvania, August 3.

*Claim.*—"What we claim as our invention is, the design and configuration of the mouldings, conical rods, petals, rosette, scroll, and foot, as herein described."

5. For a *Design for a Grate Frame and Fender;* James L. Jackson, City of New York, August 10.

*Claim.*—"What I claim therein as new is, the combination and arrangement of the ornamental figures herein represented."

6. For a *Design for a Grate Frame and Fender;* James L. Jackson, City of New York, August 10.

*Claim.*—"What I claim therein as new is, the combination and arrangement of the ornamental figures herein represented."

7. For a *Design for a Grate Frame, Summer Piece, and Fender;* James L. Jackson, City of New York, August 10.

*Claim.*—"What I claim therein as new is, the combination and arrangement of the ornamental figures herein represented."

8. For a *Design for a Cooking Stove;* Frederick Schultz, Assignor to William P. Cresson, District of Northern Liberties, Pennsylvania, August 10.

*Claim.*—"What I claim as my invention is, the ornamental designs for a flat top cooking stove, as herein described and arranged, and represented in the annexed drawings."

9. For a *Design for a Stove;* Jacob Beesley and Edward Delany, Assignors to William P. Cresson, Philadelphia, Pennsylvania, August 10.

*Claim.*—"What we claim as our invention is, the ornamental designs for a nine-plate stove, as herein described and represented in the annexed drawings."

10. For a *Design for a Cooking Stove;* Jacob Beesley, Assignor to Richard Peterson, Philadelphia, Pennsylvania, August 10.

*Claim.*—"What I claim as my invention is, the ornamental designs for a stove, called the Complete Cook, as herein described, and represented in the annexed drawings."

11. For a *Design for a Parlor Stove;* Dutee Arnold, Providence, Rhode Island, August 17.

*Claim.*—"What I claim as my production is, the new design, consisting of the bead and lattice work, and human figures, herein above described and represented in the drawings."

12. For a *Design for a Six Plate Stove;* Samuel F. Pratt, Boston, Massachusetts, Assignor to Jagger, Treadwell & Perry, Albany, New York, August 17.

*Claim.*—"What I claim as my production is, the combination and arrangement of ornamental figures and forms represented in the accompanying drawings, forming together an ornamental design for a six plate stove."

13. For a *Design for a Cooking Stove;* John S. Perry, Assignor to Jagger, Treadwell & Perry, Albany, New York, August 17.

*Claim.*—"What I claim as my production is, the combination and arrangement of ornamental figures and forms represented in the accompanying drawings, forming together an ornamental design for a cooking stove."

14. For a *Design for a Cooking Stove;* John S. Perry, Assignor to Jagger, Treadwell & Perry, Albany, New York, August 17.

*Claim.*—"What I claim as my production is, the combination and arrangement of orna-

mental figures and forms, represented in the accompanying drawings, forming together an ornamental design for a cooking stove."

15. For a *Design for a Parlor Stove;* Ezra Ripley, Assignor to Nicholas S. Vedder, Troy, New York, August 31.

*Claim.*—"What I claim as new is, the ornamental design and configuration of stove plates, the same as herein described and represented in the annexed drawing."

16. For a *Design for a Parlor Stove Plate;* Samuel A. House, Mechanicsville, Assignor to Hiram House, Troy, New York, August 31.

*Claim.*—"What I claim as new is, the ornamental design and configuration of stove plate, the same as herein described and represented in the annexed drawings."

17. For a *Design for the Top and Front Plates of a Parlor Stove;* Samuel A. House, Mechanicsville, Assignor to Hiram House, Troy, New York, August 31.

*Claim.*—"What I claim as new is, the ornamental design and configuration of parlor stove top and front plates, the same as herein described, and represented in the annexed drawings."

18. For a *Design for Parlor Stove Front;* Samuel A. House, Mechanicsville, Assignor to Hiram House, Troy, New York, August 31.

*Claim.*—"What I claim as new is, the ornamental design and configuration of stove front, the same as herein described, and represented in the annexed drawings."

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## SEPTEMBER.

1. For an *Improvement in Smoothing Irons;* Fedral C. Adams, Aberdeen, Ohio, September 7.

*Claim.*—"What I claim as my improvement is, 1st, the basket grate, formed by the bars, as mentioned in the specification.

"2d, I claim the concave form in the top of the smoothing portion of the iron, all for the purposes set forth."

2. For an *Improvement in Machines for Making Carriage Wheels;* Chauncey H. Guard, Brownville, New York, September 7.

*Claim.*—"What I claim as my invention is, the manner of feeding up the boring spindle slowly, and bringing it back speedily, whilst the driving spindle is turned constantly in one direction, and with the same velocity, viz: by connecting the driving spindle to the boring spindle, by means of the collared bar, and by a cog-wheel on the former, gearing into a pinion on the latter, and by screw threads formed upon the said spindles, which can be alternately operated upon by the segmental nut which is placed between them, and actuated by the lever, substantially as herein set forth."

3. For an *Improvement in Refrigerators of Wort;* Adolph Hammer, Philadelphia, Pennsylvania, September 7.

*Claim.*—"What I claim as new is, the series of deep, narrow, open chambers, when made with vertical partitions so as to form passages at the bottoms thereof, for imparting to the wort a direction downward and upward, through the said chambers, in combination with shallow chambers, with which the aforesaid chambers successively communicate, and the enclosed chambers, through which flows, in direction opposite to that of the wort, a current of cold water, in the manner and for the purpose herein set forth and shown in the drawing."

4. For an *Improvement in Apparatus for Feeding Chickens;* Simeon W. Albee, Walpole, New Hampshire, September 7.

"The nature of my invention consists in attaching and arranging doors to a suitable case in such manner, that said doors will be opened inwardly by the fowls, when they tread upon steps connected by levers and rods, or their equivalents, to the doors, as will be hereafter described."

*Claim.*—"I do not claim attaching and arranging the doors to the case, so that said doors will open outwardly, as that has been previously done; but what I claim as new is, attaching and arranging the doors to the case in such manner that said doors will open inwardly instead of outwardly, when the fowls tread upon the steps; the doors being attached to the case and arranged as described, or in any equivalent way."

5. For an *Improvement in Railroad Signals;* Aurin Bugbee, Charlton, Massachusetts, September 7.

*Claim.*—"I do not claim the simple combination of a bell hung to a spring, a cord or chain leading therefrom, and a tripping lever or apparatus, which when moved in one direction, shall pull the cord and cause the bell to vibrate, as this is a well known combination applied to doors, for the purpose of sounding an alarm; but what I do claim as my invention is, the combination of a single bell, a spring, two cords, and two or more tripping arms or levers, as applied to a railway and supporting frame, at a road crossing of such railway, and so that the contraction of one of the two ropes, by change of temperature, or otherwise, may be counterbalanced by that of the other, and not draw the bell laterally out of place, as it would be likely to, were but one rope or wire used.

"And I claim the combination of the weighted or heavy flag, or signal board, with its suspension chains or cords, the windlass barrel, the over balance weight or weights, and suspension cords or chains, the leading cord passing over the pulley, the tripping lever, the spring catch, and its cord, and the tripping lever or arm; all being arranged and made to operate together, substantially as specified."

6. For an *Improvement in Preserving India Rubber;* Frederick Bronner, Vera Cruz, Mexico, September 7.

*Claim.*—"The nature of my discovery is, by applying the before mentioned quantity of campeche salt or muriate of soda to the rubber, in its sap state, and that by so doing, to prevent putrefaction and fermentation of the juice, to which more especially I confine the claim of my invention."

7. For an *Improvement in Grain Harvesters;* Daniel Fitzgerald, County of New York, New York, September 7.

"*Claim.*—"What I claim is, 1st, the arrangement and combination of two cylinders with each other, for the purpose of cutting, and bringing the cut grain into the middle between them, and delivering the same to the crib, as above described.

"2d, The construction of the cam cutter, and cam fingers so constructed, as to be drawn in, for the purpose of allowing the cylinders to throw the cut grain into the crib, as above described.

"3d, The use of a sloat or channel, to regulate the movement of the fingers, as above described.

"4th, The arrangement and construction of a crib, made to receive from the two cylinders, and hold the cut grain upright, so that it can be readily taken out for binding, in the manner above described."

8. For an *Improvement in the Manufacture of Common Salt;* James P. Haskin, Syracuse, New York, September 7.

*Claim.*—"What I claim is, the use of a screen, false bottom, or floor, in the vat or pan, containing saline waters, or brine, for manufacturing salt, to separate impurities or bitterings from the salt, substantially as herein described, or any other mode substantially the same."

9. For an *Improvement in the Manufacture of Sulphuric Acid;* Carl Hiwuchs, City of New York, September 7.

*Claim.*—"What I claim as my invention is, concentrating sulphuric acid in leaden vessels, to the strength of 66° Baume, and at a temperature below the boiling point of the acid.

"I also claim the long conducting and escape pipe, in combination with the agitating apparatus, for condensing the deleterious gases, and preserving a pure and wholesome air in the neighborhood of the establishment."

10. For an *Improvement in Composition of Enamels;* John G. Dunn and Alfred F. Howes, Lawrenceburg, Indiana, September 7.

*Claim.*—"What we claim as our invention or production is, the enamel herein before described, and of its application to brick and iron."

11. For *Improvements in Apparatus for Heating Feed Water of Locomotives, etc.;* Israel P. Magoon, St. Johnsbury, Vermont, September 7.

*Claim.*—"What, therefore, I claim as my invention is, to combine the vessel, H, with the deflector, R, the heater, W, and the chimney pipe, P, substantially as described, whereby such deflector shall not only form the bottom of the said vessel, H, but that the smoke

and exhaust steam may be made to heat said vessel, by impinging against the deflector, as specified.

"And I also claim the improvement of throwing the waste steam directly into the heater or vessel, H, and there partially or wholly condensing it, before it is passed into the tank of the tender: not meaning to claim the throwing of it into the tender from the blast pipe, and through a single pipe, connecting the blast pipe and tender, but the combining the tender and the blast pipe, E, and the heater or vessel, H, by pipes, substantially in the manner represented in the drawing, whereby the advantages herein before stated, as well as others, are obtained."

12. For an *Improvement in Whiffle-tree Hook;* Edwin A. Palmer and Adolphus J. Simmons, Clayville, New York, September 7.

*Claim.*—"What we claim as our invention is, the head, turning upon the shaft, to close the hook, the sliding catch to prevent its opening, and the spring within the head acting upon them; the whole combined and operating substantially in the manner specified."

13. For an *Improvement in Air-Tight Mail Bags;* Charles A. Robbins, Iowa City, Iowa, and Harvey Allen, Allen Grove, Wisconsin, September 7.

*Claim.*—"We are aware that hinged clasps or clamps have been used for drawing together and keeping closed the mouth of the bag; such, therefore, merely of themselves, we do not claim: but what we do claim as our invention is, forming the jaws of the clasp with a tongue and groove on their inner faces, for crimping in the elastic material of the bag, and causing it to act as packing, in effectually making air and water-tight the mouth of the bag, as herein shown and set forth."

14. For an *Improvement in a Blow Pipe for Dentists, &c.;* Julius Thompson, North Bridgewater, Massachusetts, September 7.

*Claim.*—"Now I do not claim the connecting a common blow pipe with a bellows by means of either a flexible or inflexible tube; nor do I claim the invention of a lamp for blow pipe purposes, which may be operated with a burning fluid, or oil, or any other combustible substance; nor do I claim the use of a gas flame for blow pipe purposes, instead of a spirit or other flame: but what I do claim as my invention is, 1st, The combination in one instrument of the flame of gas or a lamp with a blow pipe, so that both operating together, may be held in one hand, and the flame applied on any spot, in any direction, and for any length of time, at the will of the operator.

"2d, The arrangement of the thumb piece, or its equivalent, in combination with the flame of gas, or a lamp, and a blow pipe, so that while the instrument is held in one hand, a movement of the thumb will adjust the blow pipe to the flame in such a way as to produce any desired variation in the flame, as above described and set forth.

"I do not intend by this claim, as I have intimated above, to restrict myself to the mode of construction herein or above described, but to reserve the right to vary the same as I may deem expedient, while I attain the same ends by means substantially the same."

15. For an *Improvement in Preparing Stone in Imitation of Marble;* Hiram Tucker, Cambridgeport, Massachusetts, September 7.

*Claim.*—"What I claim as my invention is, the improvement in preparing the surface of the slate, or absorbent stone, or mineral matter, for better receiving and retaining colors, and for its quicker and better induration, than by the ordinary process of baking oil or japan on it; the same consisting in applying a drying oil or vehicle to it, as above set forth, in combination with baking it and charring it, or with burning it thereon, essentially as above specified, the charring or burning the oil being the principal of my invention or discovery, under the circumstances as stated.

"And I also claim the improvement in applying the veining and ground colors to such indurated surface, or other surface, the same consisting in applying the graining colors first, and drying them on, in combination with subsequently covering the whole surface, together with such veining colors with one or more coats of black or other colored japanning, and after the same has been dried, grinding down japanning from the veining colors, and leaving it between them, so as to form a ground as stated."

16. For a *Method of Making Lamp Tops Rivets, &c.;* Luther C. White, Meriden, Connecticut, September 7.

*Claim.*—"What I claim as my invention is, the method of making lamp tops stoppers, rivets, and other similar articles, from a disk or plate of metal, by bending it and forming it, substantially as described, so that the rim is formed of two thicknesses of metal, and the centre and flanch of one thickness, as described."

# MECHANICS, PHYSICS, AND CHEMISTRY.

*On the Iron-making Resources of the Kingdom, and the First Process in Iron-Making.* By S. H. Blackwell, Esq., of Dudley, F. G. S.*

The lecture commenced with a graceful reference to the Crystal Palace, which had brought so prominently into notice the great iron-making resources of the kingdom, and the extraordinary perfection to which some of the branches of that manufacture had attained, while it illustrated no less how those resources underlie all the departments of our manufactures, and form the basis on which all progress must rest.

The history of the iron trade may be divided into two periods—the first, terminating at 1740, when coal was introduced as fuel for smelting; the second, extending to the present time.

In 1615 there were in the whole kingdom 800 furnaces, yielding 180,000 tons; and in 1740 these had declined to 59 furnaces, producing 17,350 tons. At this period coal was introduced, and the rise was thenceforward rapid; in 1788, 70,000 tons; in 1800, 180,000; in 1825, 600,000; and in 1851, 2,500,000. In the same year, the exports of pig iron were upwards of 1,200,000 tons, besides tin plates, hardware, cutlery, and machinery, bearing a total value of £10,424,139.

The causes of this wonderful increase are mainly three—the rapid expansion of our arts and manufactures; the improvements in machinery; but, above all, the vast supplies of coal and iron contained in our mineral fields, and their happy proximity to each other, by which the ore and the coal for its smelting are obtained from the same working.

A class of ores is likely to prove so important, that some notice of it must be given. It commences on the north-east coast of England, at the river Tees, and stretching through York, Lincoln, Northampton, Oxford, and Dorset shires, is at Lyme-Regis diverted by the granite formations of Devon. Its discovery was first made at Middlesboro', between two and three years ago, where the bed is fifteen feet thick, and contains thirty per cent. of iron; and so low is the cost of its production, that the manufacturers of that district have been enabled to compete with the maker of iron from the Scotch black bands. Some idea of the extent to which this bed will ultimately be worked, may be gathered from the fact, that although the workings have been so recently commenced, 200,000 tons of stone were raised by one firm alone in the course of the past year. This ore differs in appearance and structure from any other, and on this and other accounts, although the existence of the bed in Northamptonshire had been long known, and traces of the ancient workings were to be found, it had been neglected, and it was only by the Exhibition that its extent and value had been ascertained. The supply of this iron-stone may be fairly considered as inexhaustible—that from Higham-Ferrers, in Northamptonshire, where many tracings of ancient workings have been found, yielding 55 per cent. of iron.

The lecturer then proceeded to notice the improvements in the manufacture, by which, in little more than a century, a larger quantity is now

* From the London Practical Mechanic's Journal, July, 1852.

produced by two furnaces than by the whole number in blast in 1740; while, by several single firms, fivefold the whole make of the kingdom at that period is produced.

The reduction in prices resulting from these improvements has naturally been very great, and pig iron has now fallen from 8*l.* per ton, the average in 1820, to 2*l.* 12*s.* 6*d.* It is not uninstructive to remark, that the quantity exported in the past year, with the duty on foreign iron at 30*s.*, is double the entire make of the kingdom in 1825, when the duty was reduced from 6*l.* 10*s.*

Not the least interesting part of this important history, is the consideration of the obstacles opposed by prejudice and ignorance to each successive improvement. Although the use of coal was attempted as early as 1620, the opposition on the part of the workmen was such, that its successful application did not take place till more than a century later. For a long time the most eminent firms refused to make use of the hot-blast, although now more than $\frac{19}{20}$ths of the whole produce of the country are made with it; and the application of the waste gases, although adopted most successfully in Scotland, Derbyshire, and South Wales, has hitherto failed to make its way into South Staffordshire.

An important result of the Exhibition is the acquaintance it has given us with the iron manufactures of other countries, which, in many cases, showed an excellence which we have not yet attained, but which we must reach if our pre-eminence is to be maintained. It is a dangerous mistake to suppose that we are possessed of any exclusive skill in manufacture, or that our immense natural advantages will enable us to retain the position which we hold without straining every nerve to do so. The lecturer concluded by warning the Anglo-Saxon race, "to whom work is less a toil than a passion," that with their faculties and natural privileges, they also bear the responsibility of the progress of the world.—*Proc. Soc. Arts, April* 7, 1852.

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For the Journal of the Franklin Institute.

## *Remarks on the U. S. Steamship Susquehanna.* By B. F. Isherwood, Chief Engineer, U. S. Navy.

In 1847, the United States Navy Department commenced the construction of the four steamships-of-war, *Susquehanna*, *Powhatan*, *Saranac*, and *San Jacinto*, all of which are now completed, the latest, the *Powhatan*, having made a trial trip in May last.

The *Susquehanna* left the United States on her first cruise, in June, 1851, for the East Indies, by the way of the Cape of Good Hope, and returns have been received up to January, 1852, which show her to have been signally fortunate on her passage, being favored with fine weather nearly the whole time, and with fair winds during a long portion of it; consequently, she was able to derive very great benefit from the use of her sails. Owing to the same cause, there were no opportunities for testing her steam capabilities, as the engines were not worked with wide throttles and all furnaces in operation for a sufficient length of time to obtain reliable average data; from the same cause, likewise, and the

absence of indicator diagrams, neither the power exerted by the engines nor the performance of the boiler can be accurately determined. The data, however, is furnished for approximate calculations, which the reader can make for himself, and which will be sufficiently near the truth for practical purposes.

For the sake of brevity, the performance of the vessel has been divided and placed under the heads of "*Sail alone with paddles removed;*" "*Sail alone, the paddles being turned by steam to prevent their impeding the headway of the vessel;*" "*Steam assisted by sail;*" "*Steam unassisted by sail;*" each head comprising a sufficient length of time to make the means reliable.

A synopsis of the steam log of the vessel has been tabulated, and the means given for each number of consecutive hours where the weather, sail, steam data, &c., remained constant, and the mean of these means will probably be as correct an expression of the vessel's performance, as it is possible to obtain.

The synopsis of the steam log given in the tables, includes *the whole* of the vessel's performance recorded in that log.

In the table of the "*performance under steam assisted by sail,*" it will be observed that the conditions of the vessel on the first and last line are very nearly alike, the speed of the vessel being the same; but for the time recorded on the first line, a reduced steam power was used, and the wind was allowed to act; while for the time recorded on the last line, a greatly increased steam power was used; and as the wind was on the quarter, the vessel was driven by the steam as fast as the wind followed; the latter was, consequently, without effect, which is proven by the vessel having only the same speed as before, and also by the slip of the wheels being nearly equal to their mean, when under steam alone: the slip in the former instance being only two-thirds of the mean under steam alone.

It is believed a correct account of the dimensions of the vessel and machinery, &c., &c., together with her performance, will be a valuable addition to our statistics of large ocean steamships, and a reliable guide on many points of proportion, &c., for vessels of her class and model.

## Hull.

The hull of the *Susquehanna* is built of live oak, with white oak planking, and braced with wrought iron braces, 4 inches broad by ¾ths of an inch thick. The braces are in one direction only, descending at an angle of 45 degrees from the centre, both ways, to the ends, and are placed five feet apart between centres horizontally; the hull is filled in solid above the turn of the bilge and fore and aft; the vessel is barque rigged, and in the principal sails spreads 21,230 square feet of canvass.

| | | |
|---|---|---|
| Length from forward side of rabbet of stem to aft side of rabbet of post, at a draft of water of 18 feet 6 inches, | 250 | feet. |
| Length for Custom House Measurement, | 257 | " |
| Extreme breadth, | 45 | " |
| Depth of hold, | 26½ | " |
| Burthen by Custom House measurement, | 2452 tons. | |
| Extreme breadth over guards; | 69 | " |
| Height between berth and spar deck, *in clear* of beams, | 6¾ | " |
| Depth of keel, | 1½ | " |

EHANNA.

*ent them from impeding the Vessel's speed.*

| | Boilers. | | | | | |
|---|---|---|---|---|---|---|
| | Number of furnaces of the boilers in operation. | Pounds of coal consumed per hour. | Kind of Coal. | Speed of the vessel in feet per hour. | Speed of the centre of pressure of the paddles in feet per hour. | Slip of the centre of pressure of the paddles per centum. |
| No | 6 for 12 hs. and 4 for 96 hours. | 1674 | Mixed patent fuel and Newcastle. | 47031·18 | 45169·63 | |
| No | 4 | 1762 | Do. do. do. | 45836·01 | 44154·16 | |
| Oc | 6 | 2054 | Cumberland bituminous. | 53922·84 | 47411·64 | |
| Oc | 4 for 72 hs. and 6 for 52 hours. | 1629 | Do. do. do. | 51702·66 | 55838·22 | |
| Se | 6 for 60 hs. and 4 for 24 hours. | 1900 | Newcastle bituminous. | 48661·33 | 45127·80 | |
| Se | 6 for 24 hs. and 5 for 12 hours. | 1962 | Do. do. do. | 57280·47 | 55750·98 | |
| | 5 | 1797 | Bituminous. | 50084·68 | 47927·70 | |
| Ju | 7 for 8 hs. and 6 for 8 hours. | 2775 | Cumberland bituminous. | | | 12·77 |
| Ju | 8 for 60 hs. 9 for 32 hs. and 7 for 12 hours. | 3317 | Do. do. do. | | | 10·78 |
| Ju | 12 for 96 h. 10 for 24 h. and 8 for 60 hours. | 3433 | Do. do. do. | | | 18·94 |
| | 9·43 | 3358 | Cumberland bituminous. | | | |
| Ju | 12 | 4084 | Cumberland bituminous. | | | 21·22 |
| Ju | 8 for 24 hours, 9 for 93 hs. and 10 for 72 hs. | 3565 | Do. do. do. | | | 22·45 |
| Jul | 10 | 4270 | Do. do. do. | | | 22·10 |
| Jul | 12 | 4288 | Do. do. do. | | | 19·46 |
| Jul | 9 for 34 hours, 10 for 10 h. and 6 for 16 hours. | 3808 | Do. do do. | | | 19·18 |
| Jul | 10 for 12 h. and 9 for 20 hours. | 3340 | Do. do. do. | | | 19·05 |
| Sep | 8 | 3968 | Duffryn, (Welsh) | | | 17·60 |
| Sep | 6 for 32 hs. and 8 for 80 hours. | 3183 | Do. do. do. | | | 18·19 |
| Sep | 8 for 16 hs and 6 for 4 hours. | 3245 | Do. do. do. | | | 20·63 |
| Sep | 10 | 3432 | Do. do. do. | | | 18·08 |
| Oct. | 10 for 24 h and 6 for 12 hours | 3067 | Do. do. do. | | | 19·35 |
| Oct. | 8 | 3956 | Newcastle bitumin's | | | 17·42 |
| Dec | 6 | 2279 | Liverpool " | | | 18·83 |
| Dec | 6 | 2120 | Do. do. do. | | | 21·31 |
| | 8·444 | 3279 | Semi-bituminous. | | | 19·73 |

*Position of Centre of Displacement, and of Metacentre, at the following Drafts of Water.*

| | Feet. | Feet. | Feet. | Feet. | Feet. |
|---|---|---|---|---|---|
| Drafts of water, . . . . . . | 15·500 | 16·500 | 17·500 | 18·500 | 19·500 |
| Centre of displacement below water line, . | 5·833 | 6·292 | 6·729 | 7·167 | 7·667 |
| Position of cen. of disp. before cen. of water line, | 4·583 | 4·229 | 3·938 | 3·667 | 3·500 |
| Height of metacentre above cen. of grav. of disp., | 13·583 | 12·704 | 11·896 | 11·208 | 10·621 |

*Displacement and Areas of Immersed Amidship Sections at the following Drafts of Water.*

| Mean Drafts of Vessel. | Immersed Amidship Sections. | Displacements. |
|---|---|---|
| *Ft. In.* | *Square Feet.* | *Tons of Sea Water.* |
| 15 6 | 549·000 | 2745 |
| 16 10½ | 610·875 | 3109 |
| 17 6 | 639·000 | 3277 |
| 17 7 | 642·750 | 3300 |
| 17 8½ | 648·375 | 3336 |
| 17 9 | 650·250 | 3345 |
| 17 10½ | 655·875 | 3381 |
| 18 6 | 684·000 | 3550 |
| 19 4 | 721·500 | 3683 |
| 19 4½ | 723·400 | 3791 |
| 19 6 | 729·000 | 3824 |
| 19 10 | 744·000 | 3917 |

Engines.—Two inclined, direct acting, condensing engines, with inclined air pumps:

Diameter of cylinders, . . . . . . 70 inches.
Stroke of pistons, . . . . . . . 10 feet.
Space displacement of both pistons per stroke, . . 534·51 cubic feet.
The cylinder valves of the balance puppet kind, the steam valve being made the cut-off valve by Stevens' arrrangement; the steam space between the cut-off valves and pistons in *one* end of the *two* cylinders is, . . . cubic feet.

Paddle Wheels, of the common radial kind,

Diameter from outside to outside of paddles, . . 31 feet.
Length of paddles, . . . . . . . 9 feet 6 inches.
Width of paddles, . . . . . . . . 34 "
Area of *two* paddles, . . . . . . . 54 square feet.
Number of paddles in each wheel, . . . . 26
Immersion of lower edge of paddles at 18 feet draft of water, 5 feet.

Boilers.—Four copper boilers, with double return ascending flues.

Length of each boiler, . . . . . . . 15 feet 9 inches.
Breadth of each boiler, . . . . . . . 15 feet.
Height of each boiler, (exclusive steam chimney,) . 12 " 9 "
Total area of heating surface in the four boilers, . 8652 square feet.
Total area of grate " " " . 342 "
Aggregate cross area of the first row of flues in the four boilers, 82 "
Aggregate cross area of the second and third row of flues in the four boilers, (each,) . . . . . . 52 "
Cross area of the chimney, . . . . 54 "
Number of furnaces in the four boilers, . . 12
Height of smoke chimney above grates, . . 65 feet.
Weight of the four boilers and appurtenances, 184·4 tons.
Weight of sea water in the four boilers, . . . 126 tons.

Total length occupied in the vessel by the machinery, from bulkhead to bulkhead, 102 feet 9 inches, including a forward coal hold of 12 feet 9 inches fore and aft; the length occupied by engines, boilers, and fire rooms, is 90 feet; the bunkers stow 900 tons of coal.

*Statistics of the Machinery of the Susquehanna.*

| | Weight of material in a finished state. lbs. | Finished Surfaces. sq. in. | Labor. No. of Days. | Total Cost. Dolls. Cts. |
|---|---|---|---|---|
| Engines (complete) with paddle wheels, engine room, floor, &c., &c. | | | | |
| Weight of material in a finished state. | | | | |
| Cast iron, 350,688 lbs. | | | | |
| Wrought iron, 310,544 " | | | | |
| Brass Composition, 54,596 " | | | | |
| Copper, 21,398 " | | | | |
| Steel, 1,776 " | 739,002 | | | |
| Finished Surfaces. | | | | |
| Planing, 81,541 sq. in. | | | | |
| Boring and turning, 662,859 " | | 744,380 | | |
| Day's Labor. | | | | |
| Number of days' work fitting, 19,562 | | | | |
| No. of days' work of laborers, 1,161 | | | 20,723 | 165,085·82 |
| Boilers. | | | | |
| Weight of material in a finished state. | | | | |
| Copper plates and bolts, 313,845 lbs. | | | | |
| Brass composition, 10,437 " | 324,282 | | | 121,481·67 |
| Appurtenances to boilers, viz: smoke pipe, jackets, holding down bolts, furnace and flue doors, grate bars, safety, feed, blow, and steam stop valves, water pans, fire room floor, &c., &c. | | | | |
| Weight of material in a finished state. | | | | |
| Cast iron, 60,783 lbs. | | | | |
| Wrought iron, 20,684 " | | | | |
| Brass composition, 4,832 " | | | | |
| Copper, 2,652 " | 88,951 | | | |
| Finished surfaces. | | | | |
| Planing, 5,365 sq. in. | | | | |
| Turning and boring, 20,998 " | | 26,363 | | |
| Days' labor. | | | | |
| Number of days' work fitting, 286 | | | | |
| No. of days' work of laborers, 227½ | | | 513½ | 8,973·44 |
| Coal bunkers and bulkheads, engine room, galley, &c. | | | | |
| Weight of material in a finished state. | | | | |
| Cast iron, 19,121 lbs. | | | | |
| Wrought iron, 99,281 " | | | | |
| Brass composition, 461 " | 118,863 | | | 13,909·14 |
| Patterns. | | | | |
| Days labor on patterns, 2219 | | | 2,219 | 7,867·43 |
| Duplicate pieces, tools, stores, outfits, &c. | | | | |
| Weight of material in a finished state. | | | | |
| Cast iron, 55,910 lbs. | | | | |
| Wrought iron, 9,813 " | | | | |
| Composition, 6,631 " | | | | |
| Copper, 471 " | | | | |
| Steel, 59½ " | 72,884½ | | | |
| Finished surfaces. | | | | |
| Planing, 732 sq. in. | | | | |
| Turning and boring, 1040 " | | 1,172 | | |
| Days' labor. | | | | |
| Number of days' work fitting, 377 | | | | |
| No. of days' work of laborers, 10 | | | 387 | 7,363·47 |
| Totals, | 1,343,982½ | 772·515 | 23,842½ | $324,680·97 |

## PERFORMANCE.

### *Performance under Sail alone, with Paddles removed.*

The performance of the *Susquehanna* at sea, under sail alone, with the paddles removed, was for three consecutive days as follows, viz:

| | | |
|---|---|---|
| July 8, 1851, | | 178·25 knots. |
| July 9, | " | 174·00 " |
| July 10, | " | 175·00 " |

Mean speed per hour, 7·323 knots.

During this period, the course of the vessel was S.W.½W.; the wind was a moderate breeze from N. E., or directly aft. All sail was carried that could be advantageously set.

With the course of the vessel and the strength of the wind, as above, but the direction of the wind being from the E., or on the port quarter, all sail set as before, the speed of the vessel was as follows, viz:

| | | |
|---|---|---|
| July 11, 1851, | | 150·50 knots. |
| July 12, | " | 159·25 " |
| July 13, | " | 159·50 " |

Mean speed per hour, 6·517 knots.

On the 14th July, 1851, the course of the vessel and direction of the wind being the same as in the last paragraph, but the wind being only a light breeze, the vessel made but 99 knots, or 4·125 knots per hour.

Throughout all the above sailing, the sea was smooth and the weather fine; mean draft of the vessel, about 19 feet.

The above is all that is recorded in the log of the performance of the vessel under sail alone, with the paddles removed. The paddles, though newly put on, and with copper bolts and nuts, required two hours to take off 11 in each wheel, the sea being smooth and the weather fine.

### *Performance under Sail alone, the paddle wheels being turned by steam only as fast as was necessary to prevent them from impeding the Vessel's speed.*

For the sake of brevity, I have tabulated from the steam log of the vessel, all of her performance under the above conditions.

From the annexed table it will be seen that the means of 492 hours' performance under sail alone, with the paddle wheels turned by steam to prevent their dragging, were as follows, with ordinary sea, moderate breeze ranging from abeam to aft, all sail set, and vessel drawing 17 ft. 4 in. forward, and 18 ft. 8 in. aft; immersion of lower edge of paddles, 5 ft. 4 inches.

| | |
|---|---|
| Speed of vessel per hour, | 8·234 knots. |
| Steam pressure in boiler per square inch above atmosphere, | 7·1 pounds. |
| Double strokes of piston per minute, | 8·73 |
| Steam cut off at from commencement of stroke, | 5 feet, or ½ |
| Throttle open, | 0·15 |
| Number of furnaces in operation, | 5 |
| Consumption of bituminous coal per hour, | 1797 pounds. |
| Consumption of bituminous coal per 24 hours, | 19¼ tons. |
| Excess of the vessel's speed over the speed of the centre of pressure of the paddles, | 4½ per centum. |

Cost of the "Susquehanna."

| | |
|---|---|
| Hull, | $310,933 |
| Masts and spare spars, | 8,936 |
| Boats, | 4,934 |
| Rigging, | 18,926 |
| Sails and spare sails, | 12,383 |
| Tanks and casks, | 4,595 |
| Anchors and cables, | 16,212 |
| Furniture, | 2,260 |
| Miscellaneous, | 1,810 |
| Machinery, | 324,681 |
| Armament, three 10 inch guns, and six 9 inch guns, | 4,738 |
| Ordnance equipments and stores for three years, | 20,240 |
| Engineer's stores, | 7,185 |
| All other stores, | 14,724 |
| Total cost of vessel equipped and fitted for a three years' cruise, | $752,557 |

Weights of the Susquehanna.

| | | |
|---|---|---|
| Hull, (including wheel houses, guards, engine, keelsons, &c.,) | 1704 | tons. |
| Masts, rigging, and sails, | 82 | " |
| Boats, | 9 | " |
| Cables and anchors, | 82 | " |
| Armament, | 97 | " |
| Men, | 35 | " |
| Tanks, casks, water, and dunnage, | 142 | " |
| Provisions, | 75 | " |
| Various equipments, galley, furniture, &c., | 20 | " |
| Stores in various departments, | 44 | " |
| Total weights in steam department except coal, | 726 | " |
| Coal in bunkers, | 900 | " |
| Total weights, | 3916 | " |

For the Journal of the Franklin Institute.

## *On the Telegraphic Lines of the World. By* Dr. L. Turnbull.

Continued from page 138.

### France.

The French are inferior in telegraphic enterprise to most of the other European countries. In that country the telegraph is under the control of government officers, and all the government business is done by signals, understood by those only who are in the pay of the government; the tariff is too high, and but little use is made of it, as the existing government does not wish it brought into general use: this is much unlike the republicanism of the U. States. The principal instruments in use are those of Brèquet and Foy, which prints from 10 to 12 signs per minute; this is used along the railroad from Paris to Rouen. Wheatstone's needle telegraph and also the instruments of Dugardin and Gardiner are made use of. That of Brett is employed on the connecting line of England and France, between Dover and Calais, and Bain's Chemical Telegraph has more lately been introduced. The lines mostly originate in Paris, from which they stretch northward to Amiens, Arras, Valenciennes, Douae, Lille, Dunkirk, Calais, and Boulogne. South, they extend to Orleans, Louis,

Chevres, Angiers, Blois, Bourges, and Chateauroux; East, to Chalons, on the main; West, to Versailles, Rouen, Havre, and Dieppe: the whole extent being from 400 to 600 miles. Another line is about to be, or is opened from Paris to Lyons. In last April, the government published the establishment of several offices on each line which could be used for private correspondence; there were six of these points on the northern line, the same number on the southern, two on the western, and one on the eastern. The committee appointed for the purpose, recommended a general distribution of them on all the lines. The government have adopted the following tariff of charges, for a despatch of twenty words, including the names of the sender:—

| | | | | | | |
|---|---|---|---|---|---|---|
| From Paris to Arras, | 4 f. | 80 c. | From Paris to Angers, | 5 f. | 88 c. |
| " Valenciennes, | 5 | 64 | " Bourges, | 7 | 60 |
| " Lille, | 6 | 36 | " Nevers, | 5 | 88 |
| " Calais, | 6 | 36 | " Chateauroux, | 6 | 72 |
| " Dunkirk, | 7 | 56 | " Chalons, | 6 | 24 |
| " Orleans, | 7 | 32 | " Rouen, | 5 | 70 |
| " Tours, | 4 | 56 | " Havre, | 5 | 76 |

To estimate the expense between each of these places, it is only neces sary to find the difference of that between them and Paris respectively. For despatches of more than twenty words, a fourth is to be added for every ten words, so that this tariff will be double for sixty words.

I have translated the following list of the lines of France, from the "Traité de Telegraphic Electrique," by Moigno, second edition, 1852.

1st, Line of the North, from Paris to Valenciennes, by Amiens, Arras, Douae, Lille, with a branch to Dunkirk, Calais, and Boulogne, 90 leagues.

2d, Line of the South, from Paris to Chateauroux, by Orleans, Blois, Tours, Bourges, with a continuation to Bordeaux one way, and another to Nantes.

3d, The line of the East, from Paris to Chalons sur Marne, prolonged to Strasburg, by Vetoy, Nancy, &c.

4th, The line from Paris to Havre, by Rouen and Dieppe.

5th, The line of Montereau to Troyes.

6th, The line of Metz to Nancy, &c.

The entire length of the finished lines form three hundred leagues, (about 750 English miles,) and according to Moigno, they have committed the irreparable fault of suppressing the old telegraphs.

## Holland.

The instrument used in Holland is a modification of Morse's by Mr. Wm. Robinson; this gentleman is an American; he has obtained the privilege of erecting and managing lines of magnetic telegraph, in the United Kingdoms of Norway and Sweden, for fifty years. A company of heavy capitalists of this city and Stockholm, have commenced in the work, which is to begin immediately. A similar privilege is expected from the Government of Denmark. Most of the Belgian and Holland Railroad Companies have constructed telegraphs; there is one now in operation from Amsterdam to Rotterdam, and the Government of Holland has authorized the construction of one from Amsterdam to the Helder, and one from Rotterdam to Vleissingin.

### Italy.

Considerable progress has been made in the construction of lines throughout the Italian States. By virtue of an ordinance of the Minister of Public Works, the telegraphs which are to connect Rome on one side with Cevita Vecchia and the sea, and on the other side with the Austrian boundary at Ferrara, will be established at an early day.

### Spain.

In Spain, the line from Aranjuez to Madrid is complete, and others are being laid down to Seville, Cadiz, Valenten, Barcelona, and the frontier of France. Before long there will be a general telegraphic communication from one extremity of Europe to the other, and when the connexion between Dover and Calais shall have been completed, the people of London will be able to communicate with those of nearly every capital on the continent, extending over a space of nearly 6000 miles.

### Russia.

A Prussian engineer has gone to St. Petersburg, in order to establish electro-magnetic telegraphs throughout the whole Russian monarchy.

### Mexico.

A contract has been entered into by the Mexican Government, with Wm. George Stewart, Esq., the Mexican Consul at New York, and Senor Juan de la Grariga, of Mexico, to construct a line from Vera Cruz to the City of Mexico, a distance of three hundred miles; one hundred and twenty of which, as far as El Oge de Argua, was to have been completed on the 1st of May, 1851. Another line will soon be built between Acapulco and the City of Mexico. When both are completed, there will be a magnetic communication between the Atlantic and Pacific.

A letter from Mexico informs us of the progress of the magnetic telegraph in that country. It appears that the party who went from the U. States to that country for the purpose of putting up a line of telegraph from the City of Mexico to Vera Cruz, have finished it from the former city to Napolucan, a distance of about 150 miles, and half way to Vera Cruz. The other half will be finished in two and a half months. The line already up is doing a very fair business; the receipts averaging $35 per day, and the expenses about $15. These receipts will be largely increased when the line is finished to Vera Cruz, as the largest portion of the business transactions of the country is between that City and the City of Mexico, including Puebla and Orizaba. Another line is in contemplation from the City of Mexico to Acapulco, on the Pacific, 300 miles further, which will connect the Atlantic and Pacific. This will be a highly important connexion, considering our California possessions on the Pacific.

Mexican advices to Sept. 4th, says: Sr. Don Juan de la Granja has finished the telegraphic line from Vera Cruz to Mexico, and is about to undertake the construction of another line from Mexico to Guanajuato.

### Cuba.

The Governor General has ordered the publication of the concessions made to companies for the establishment of electric telegraphs through all points, and to the principal cities of Cuba. The lines will be established

from Villanueva to Union, crossing several small towns in their way; from Union to Matanzas; from Buerba to Macagua; from Tinguaro to Jucaro; from Navagas to Isabel; from San Felipe to Batabano, and from Rincon to Guanajay, by San Antonio. The companies will be obliged to commence the works six months after the date of the concession, and to establish them with the greatest possible activity.

The Cubaneras have discovered the benefits the magnetic telegraph confers by facilitating business and transmitting communications from one point to another. They are, therefore, setting about establishing telegraph lines throughout the Island. Two companies have been formed for this purpose. One of these companies, with a capital of $20,000, propose a line from Havana to Cienfuegos, passing through Isabel, Trinidad, and Manzanillo, to Cuba. From this point it will be extended to Bayams, and thence to Guanagos and Pinar del Rio, ending at San Juan and Martenez. The second line, which also starts from Havana, will communicate with Cardenas, Matanzas, Siena, Morena, Sagua la Grand, San Juan de los Remedios, Neuvitas, Moron, and Halguin, and will end at Cuba, having three branches to Puerto Principe, Sancto Spiritus, and Villa Clara. The same company propose a line from Havana to Hariel, Cubanas, and Bahia Honda; the capital of this company is $300,000. These lines, when completed, will connect the capital with every considerable town on the Island.

### VALPARAISO.

The telegraph between Valparaiso and Santiago, is progressing rapidly. Messages have already been sent over one-third of the line, (from Casa Blanca to this city.) From present appearances, the line will be through in less than forty days, as the poles are already up more than three-quarters of the distance.

### INDIA.

This all-infusing enterprise has aroused the lethargic inhabitants of the tropical climate. An electric telegraph has been erected in India, and is now in successful operation: the telegraph will soon belt both continents.

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## *On the Influence of Sulphur upon the Nature of Cast Irons.* By M. JANOYER, Director of the Blast Furnaces of Orme.*

In the present memoir I shall describe some experiments which I have made in order to ascertain the influence which sulphur exercises upon the nature of cast irons. All works on metallurgy, which have treated of the action of the simple non-metallic bodies upon cast iron, point out, it is true, the tendency of sulphurous ores to produce white metal in their treatment in the blast furnace, but not one gives any information respecting the mode of action of the sulphur. It is generally admitted that sulphur renders cast iron too fusible, and consequently difficult to convert into gray metal. This explanation, which has some truth in it, is not sufficient, seeing that very gray cast iron may be easily produced with highly phosphorized, and consequently very fusible ores. The disinte-

* From the London Chemical Gazette, June 15, 1852.

grated oolitic ores of Villebois and of Tremblois, which contain a large proportion of phosphorus, furnish tolerably good results. It is necessary to admit, independently of the great fusibility, some chemical action of the sulphur,—a decarbonizing action upon the iron.

The charge for the blast furnaces of Orme, situated in the coal basin of the Loire, consists essentially of two kinds of ores, viz:

| Compact peroxidized ore of Privas. | | Carbonated ore of the coal measures. | |
|---|---|---|---|
| Clay, | 16·55 | Clay, | 73·15 |
| Peroxide of iron, | 70·05 | Protoxide of iron, | 37·02 |
| Lime, | 5·88 | Sulphuret of iron, | 5·98 |
| Water and volatile substances, | 7·52 | Lime, | 0·86 |
| | | Magnesia, | 0·55 |
| | 100·00 | Water and volatile matters, | 42·00 |

The first is a compact ore, of an average degree of reducibility, and tolerably fusible; the second is both easily reducible and fusible, but it contains much sulphur; the gangue of both is argillaceous.

Of these two ores, that of the coal measures (especially when calcined,) presents, excepting the sulphur, all the conditions essential for gray cast iron with large and open grain; and to protect it from the great fusibility of the sulphurous cast irons, and preserve it from the action of the sulphur and silicon, which weaken the tenacity, I treated this ore with a large proportion of lime, in order to facilitate the formation of a sulphuret of calcium and a silicate of lime, and thus to get rid of these two injurious substances.

The first day, the blast-furnace working hot and very regularly, gave a very gray iron; but the nature of the product soon changed; the iron became porous (*truitée*), fibrous, white, and lastly cavernous, granular and white, although the working of the blast-furnace remained good and regular.

I had not to fear an incomplete reduction, owing to the great fusibility of the sulphuretted irons (fusion before reduction), for the corresponding slag was white, stony, and without a trace of protoxide of iron. There was no variation in the atmosphere; the blast applied preserved the same temperature and pressure; there was no alteration in the combustible, nothing, in fact, which would account for such a change in the product. I then attributed the change observed to a cooling of the lower part of the furnace, owing to the formation of the excessively basic slags which I sought to produce. Their analysis gave—

| | | |
|---|---|---|
| Silica, | 34·50 | |
| Alumina, | 18·00 | (without a trace of iron.) |
| Lime and magnesia, | 47·00 | |
| Sulphur, | 0·13 | |
| | 99·63 | |

To obtain a less basic slag less difficult to fuse, I progressively diminished the amount of lime. The working of the furnace continued constantly hot and regular; but the iron, instead of improving, became more and more cold. On being run from the furnace, a loud decrepitation was audible, and it quickly solidified; on fracture, it was coarse and sometimes cavernous; it exhibited in every respect the character of a cast iron produced with a cold working, the carburation being imperfect, although the appearances

of the working, of the slag, the flame at the throat of the furnace, indicated the contrary. By diminishing the amount of flux without varying the other elements of the slag, I restored to the crucible the heat which might have been abstracted by the formation of too basic a slag; on the other hand, I isolated a larger amount of sulphur; the product became worse and worse, so that I was led to attribute to the sulphur alone the deterioration of the cast iron. I imagined that the whitening of the iron was due to the subtraction of a part of the carbon of the cast iron in the form of sulphuret of carbon, and to the heat rendered latent by the volatilization of this body. I then made various synthetical experiments, in order to prove this kind of action of the sulphur upon the carbon of the cast irons.

3 grms. of a beautiful large-grained gray iron were treated with *aqua regia*, and the solution mixed with chloride of barium; I obtained 0·02 sulphate of baryta = 0·0027 gr. sulphur, or 0.09 per cent. of the weight of the cast iron.

Knowing exactly the amount of sulphur, I re-smelted—

1. 32 grms. of this same metal with 0.64 of pyrites (bisulphuret of iron), perfectly crystalline and without gangue.

2. 40 grms. with 0·40 pyrites, to see whether this iron, after whitening, would contain more sulphur, and how much it would increase or diminish in proportion as the amount of pyrites was increased or diminished. When the material was fused and very liquid, I uncovered the crucible, and perceived some brilliant globules of a more intense white than the fused metal, which were disengaged between the sides of the crucible and the metallic button, and disappeared on contact with the air, producing at this spot a very perceptible lowering of the temperature. When the disengagement had ceased, I let the metal cool very slowly in the crucible in which it had been fused, to be certain that the whitening did not proceed from a too sudden cooling. Notwithstanding this precaution, the metal, which till then had remained tranquil with a smooth surface, opened in all directions, produced a loud decrepitation, and became covered with an uneven crust, which separated partly from the metal, and presented in every respect the characters of a granular iron produced by an imperfect carburation in a bad working. When broken, the cast irons were white, and the more so in proportion to the amount of pyrites. They were excessively hard; a file of cast steel would not act upon them.

I examined these white metals. 3 grms. of each were treated with *aqua regia*, and the solution mixed with chloride of barium. The first gave 0·19 grm. sulphate of baryta = 0·026 of sulphur = 0·87 per cent. of the weight of the metal. The second gave 0·10 sulphate of baryta = 0·0133 of sulphur = 0·46 per cent.

From these two assays, it will be seen that the cast iron contains, after this fusion, a greater proportion of sulphur, and that this proportion increases almost in the same relation as that of the pyrites added, since in the first case we find nearly twice as much sulphur as that given in the second experiment, which contained exactly half the amount of pyrites. This is what I expected in some measure, for the pyrites lose by heat the half of its sulphur on being changed into more stable protosulphuret, and the affinity of the sulphur for the iron would necessarily give rise to

the combination of the sulphur set free with the metal. The composition of the pyrites is—

| | |
|---|---|
| Sulphur, | 54·26 |
| Iron, | 45·74 |

An assay in the dry way, made with the mixture of 2 per cent. pyrites, contained before fusion 1·06 per cent. of sulphur; if the half, which was disengaged from the bisulphuret by heat, had combined entirely with the metal, I ought to have found the same amount of sulphur, whilst analysis only gave 0·87 per cent., from which must still be deducted 0·09 per cent. which the first cast iron contained, leaving 0·78 per cent. as the entire amount of sulphur which the metal took up in the fusion with pyrites. There was, therefore, a loss in this operation of 0.28 per cent. of sulphur.

The first experiment made with the mixture of 1 per cent. pyrites, which therefore contained before fusion 0·53 per cent. of sulphur, furnished only 0·46 per cent. of sulphur, from which must be subtracted, as in the first case, 0·09 per cent. contained in the metal, leaving 0·37 per cent. In this smelting there was, therefore, a loss of 0·16 per cent. of sulphur.

From the results of these two experiments, it is evident—1st, that the irons contain the more sulphur the larger the amount of pyrites present when they are re-smelted. 2d, that there is a loss of sulphur after complete fusion, and that this loss at a certain time is greater the larger the proportion of pyrites.

These facts once established, it is highly probable, if not certain, that this portion of the sulphur is lost by forming with the carbon of the irons volatile sulphuret of carbon, which produced the brilliant globules observed in the above experiments.

To arrive at a certain proof, I repeated comparatively the experiments previously made by M. Berthier upon a mixture of perfectly clean soft iron filings and pyrites. M. Berthier found, that, by fusing clean soft iron with pyrites, atom for atom, protosulphuret of iron is always formed without any *loss of sulphur*. If this were the case, it is proved that the sulphur lost in the preceding experiments, combined with the carbon of the irons, forming sulphuret of carbon, which had a decarburating action, and produced at the same time some latent caloric by its volatilization; for it is known that on evaporation this liquid produces a decrease of temperature capable of freezing mercury.

I made a first experiment by fusing in a naked crucible before the forge 20 grms. of soft iron filings, well cleansed, with 0·40, *i. e.* 2 per cent. of pyrites. To avoid a slight oxidation by the air which might have entered the crucible, I covered it with a piece of coke; and when the whole mass had arrived at a white welding heat, I uncovered the crucible to see whether in this case there was any liberation of brilliant globules, as in the fusion of the iron with 3 per cent. of pyrites; I could perceive none; the mass remained quiet, and when cold, presented the form of a tolerably compact, uniform button; on being broken, some rather dark yellowish-brown sulphuret of iron was apparent here and there, which was without a doubt protosulphuret disseminated throughout the mass. This first experiment I considered a proof of the forma-

tion of sulphuret of carbon by the fusion of gray iron in the presence of pyrites, as only in this case did I observe the liberation of brilliant globules.

I made a second experiment, in which I determined the amount of sulphur. 2·31 filings of well cleansed iron wire were fused with 2 per cent. of pyrites; I obtained a well-fused compact button, which was easily acted upon by the file. 1·05 was treated with nitro-muriatic acid; it dissolved slowly, but entirely; the solution was precipitated by chloride of barium, and I obtained 0·08 grm. sulphate of baryta, or =1·04 per cent. of sulphur, instead of 1·05 per cent., which the mixture must have contained before the fusion. I thence concluded, as M. Berthier had done, that in the fusion of clean soft iron with pyrites, there is never any loss of sulphur. Therefore, as I have stated at the commencement, we must not attribute to the too great fusibility alone the tendency which sulphurous ores have to yield white irons. The principal cause is due to the formation of a sulphuret of carbon, which acts by decarbonizing in part the metal, and by producing a considerable lowering of the temperature from the caloric rendered latent by the volatilization of this product.

I have stated above, that, on fusing gray metal with variable proportions of pyrites, it became deteriorated, and I have supported this statement by experiments. It remained to be seen whether the same would occur, if, instead of operating upon the cast iron, we were to take the ores. I therefore reduced 20 grms. of the Privas ore with 2 grms. of lime, the whole mixed with 2 per cent. of pyrites in a crucible lined with charcoal. The metal was allowed to cool very slowly in the crucible; but notwithstanding this precaution, the fracture of the button was entirely white, and exhibited in the portion in contact with the slag some yellow plates of sulphuret of iron. Throughout its thickness, it presented large cavities coated with filamentary crystallizations of sulphuret of iron. In the massive portions, the metal had a granular appearance. Altogether, it was very bad, exceedingly brittle, and exhibited not the least elasticity under the hammer.

20 grms. of the same piece of ore, reduced in a lined crucible with 2 grms. of lime and 1 per cent. of pyrites, likewise furnished a very white metal, although cooled very slowly. The button exhibited, like the preceding one, large cavities coated with filamentary crystallizations; the iron was bad and brittle, and without elasticity. The only difference was, that there were no yellow plates of sulphuret of iron perceptible at the junction of the metal and of the slag.

To be certain that, on treatment in the blast-furnace, the pyrites, or rather the sulphur of the pyrites, was an obstacle to the production of a gray metal, I treated 20 grms. of the same piece of ore which had served for the preceding experiments with the same amount of flux without any addition of pyrites. The metal obtained was gray, without, however, being graphitous; it yielded slightly to the hammer, was perfectly compact in the interior, and showed no sulphurous crystallizations. I was, however, able to distinguish with the aid of the lens some minute filaments of sulphuret of iron at the place of contact of the slag with the metal. On analysis, I obtained but a trace of sulphate of baryta.

I now proceeded to determine the amount of sulphur in the metal obtained in the two first experiments, by reducing the ore in the presence of pyrites, in order to see whether also, in this case, acting upon the ores and not on the metal, the latter would contain an amount of sulphur greater in proportion to the quantity of pyrites present. The experiment which had been made with the mixture of 2 per cent. of pyrites furnished, on the analysis of 1 grm., 0·07 sulphate of baryta=0·96 per cent. of sulphur. As the mixture contained previous to fusion 1·06 per cent., we have a loss of 0·10 per cent.

1 grm. of the metal obtained in the experiment made with 1 per cent. of pyrites furnished 0·03 grm. sulphate of baryta =0·41 per cent. of sulphur; since the mixture contained 0·63 per cent. of sulphur, we here again meet with a loss of 0·12 per cent.

It is evident, from these experiments, that the metals contain the more sulphur the more the ores from which they are produced contained pyrites, the proportion of flux remaining invariable.

In order to prevent the injurious influence of the sulphur upon the iron in the treatment of pyritous ores in the blast-furnace, I increased progressively the amount of flux; for, according to M. Berthier, the lime decomposes a considerable quantity of sulphuret of iron at a high temperature in the presence of carbon. In order not to interfere with the fusibility of the slag, I first of all endeavored to ascertain the maximum quantity of lime it might contain. By fusing together the clay and the lime, experiment led me to the following composition as the limit which should not be exceeded:

| | |
|---|---|
| Silica, . . . . . . . . | 36·00 |
| Alumina, . . . . . . . . | 10·00 |
| Lime, . . . . . . . . | 54·00 |

Having made this experiment, I obtained, by adding gradually lime to the charge of the blast furnace, a white stony slag containing not a trace of oxide of iron, and approaching closely to the above composition; there were here and there particles of uncombined lime mechanically intermixed. The working of the blast-furnace was constantly good and regular, the combustible very good, and the blast heated to 750°, so as to restore the heat abstracted by this enormous amount of lime.

Notwithstanding this maximum amount of flux added to the charge, I was not able to prevent the action of the sulphur; and to obtain good *gray* metal, it was necessary to subtract a large quantity of the highly pyritous ores of the coal measures.

I next proceeded to ascertain what became of the sulphur on effecting the reduction in lined crucibles. I took:—I. 10 grms. of the ore from Privas, 5 grms. of the slag from the blast-furnace, 5 grms. of lime, and 0·20 of iron pyrites. II. 10 grms. of the ore from Privas, 5 grms. of slag, 10 grms. of lime, and 0·20 of iron pyrites.

The two experiments succeeded perfectly. The first gave a well-fused, vitreous, bright gray slag. However, throughout the portion of the slag which surrounded the button, a hard, whitish-yellow, compact substance, with a smooth fracture, was disseminated. The button of metal was quite white, with a very irregular fracture, very cavernous, and exhibiting a few filaments of a sulphurous crystallization. Three

little balls of metal, which did not adhere to the button, but rested above the slag, had escaped the decarbonizing action of the sulphur; for with a lens, and even with the naked eye, several large laminæ of graphite were perceptible, and the metal was perfectly black. The mixture of the ore, lime, and pyrites not having been perfect, a small quantity of the ore had been reduced, protected from the action of the sulphur, which, on the contrary, had strongly acted upon the button of metal. On analysis, 1 grm. of this white iron gave 0·009 sulphate of baryta = 0·1242 per cent. of sulphur.

The second experiment, in which there was double the amount of flux—the maximum quantity of the fusibility of the slag,—furnished a grayish-white slag filled pretty uniformly with the yellowish-white substance, which in the previous experiment had occurred here and there disseminated in the scoria; it had a shining yellow appearance, and when exposed to moist air, fell for the greater part into a powder, and furnished an enormous quantity of quick-lime. Notwithstanding the powerful affinity which this large amount of lime must have presented for the sulphur, the metal was entirely white, with a granular cavernous appearance, but exhibited no trace of a sulphurous crystallization; it was much more malleable than that obtained in the preceding experiment; it was rather difficult to reduce to powder, and in the mortar flattened out. Although white, it was easy to observe that there was a great improvement in its tenacity. I grm. of this whitish metal gave 0·005 sulphate of baryta = 0·069 per cent. of sulphur, which is scarcely more than half the quantity found in the preceding experiment.

From these two conclusive experiments it is seen, that the amount of sulphur in cast iron diminishes in proportion as the amount of lime contained in the slag increases, but that it is impossible, in certain cases, to remove it altogether without rendering the slag infusible. I have stated, in speaking of the experiment made by fusing 10 grms. of the Privas ore, 5 grms. of slag, 5 grms. of lime, and 0·20 pyrites, that the slag which surrounded the button was altogether compact and yellowish-white, whilst the rest of the scoria was vitreous, and showed nothing similar. The analysis of this portion proves, from the presence of the large amount of sulphur, that some sulphuret of calcium is mixed with the slag; and from its being in immediate contact with the whitened metal, it is evident that the sulphuret of calcium has been formed by some sulphurous emanations from the metal. This slag had the following composition:—

| | |
|---|---|
| Silica, | 40·07 |
| Oxide of iron and alumina, | 15·00 |
| Lime, | 43·75 |
| Sulphur, | 0·50 |

On comparing the result obtained in the analysis which gave 0·069 per cent. of the weight of the metal with the sulphur previously found in a very gray metal (0·09 per cent.), it is quite evident that the whitening must not be attributed to the sulphur combined with the iron,—sulphur which might form a true sulphocarburet of iron, and prevent the isolation of the graphite. It is owing to the loss of sulphur,—as shown by the two experiments made by fusing at first gray metal, and subsequently clean soft iron with pyrites,—which combines with the carbon,

forming very volatile sulphuret of carbon, and rendering a large amount of caloric latent. Hence we have the whitening produced by two simultaneous actions,—subtraction of a portion of the carbon of the cast irons, and lowering of the temperature from the volatilization of the sulphuret of carbon.

With respect to the position in which the sulphuret of carbon is formed in the blast-furnace, it may be admitted that it is produced wherever the temperature is at a red heat, bearing in mind that Lampadius detected sulphuret of carbon by heating to redness some pyrites and charcoal, and that these conditions occur in the blast-furnace. On the other hand, the analyses of the gases by M. Ebelmen, have not shown its presence, although the latter assumes that probably the sulphur exists in the gases in the sulphuret of carbon, but in inappreciable proportion. We must, therefore, attribute its absence to the highly reductive properties which the sulphuret of carbon possesses, which could not exist in the presence of oxide of iron. In proportion as it was formed, it would be decomposed into sulphuret of iron and oxide of carbon.

It is also possible that the pyrites, on losing the half of its sulphur by heat, yields it to the iron already reduced, converting it into protosulphuret without the formation of any sulphuret of carbon, and we arrive at the same result, that is, the conversion of the iron into protosulphuret in its progress through the furnace.

The flux not having lost the whole of its carbonic acid, does not possess sufficient affinity for the sulphur to decompose the protosulphuret of iron which is constantly being formed. It is only in the neighborhood of the *tuyères*, when the flux has been entirely changed into caustic lime and partially into calcium, that the affinity of the carbon in a nascent state (graphite), together with that of the lime for the sulphur, determines the decomposition of a part of the protosulphuret of iron. There is then formed sulphuret of carbon at the expense of the carbon of the cast iron, and caloric thereby rendered latent. Another portion of the sulphur combines with the calcium.

The sulphuret of carbon formed in the crucible itself, must be again partially burnt by the blast, from which would result sulphurous and carbonic acids, which would reproduce some sulphuret of iron and calcium, and oxide of carbon; and it should be remarked here, that the proportion of sulphuret of calcium will be the more considerable the greater the amount of lime present in the charge. It follows, from this, that in order to obtain a metal which shall contain the minimum amount of sulphur, it is necessary that the slags should contain the maximum amount of lime. I may also add, that in this case the working of the furnace should be as hot as possible, in order to facilitate the isolation of the graphite, and consequently the formation of the sulphuret of carbon, which serves to transfer the sulphur from the metal to the slag.

The author observes, in conclusion, that a considerable improvement has recently been effected in the working of the blast-furnaces and their products by washing the coals, which removes a great portion of the pyrites, and also, by getting rid of the earthy matters, increases the heating power of the coal.—*Annalen des Mines*, Feb. 1852.

For the Journal of the Franklin Institute.

## *Steamboat Accidents. Loss of the Henry Clay—The Atlantic—The Reindeer.*

The reckless mismanagement of steam boilers, which is so constant and just cause of reproach to our country, has been, within the last few weeks, more than usually destructive of life and property. During the earlier months of the year, it was with some trouble that we could keep the run of such accidents on the Mississippi and its tributaries; but it was with an unusual shock that we heard of the first of the accidents to which we intend particularly to refer, in consequence of its taking place on the Eastern waters, which have been comparatively free from such occurrences. The completion of the New York and Albany Railroad, running along the North river, rendered it apparently requisite that unusual efforts should be made by the steamboat proprietors to maintain their popularity, and numerous projects were spoken of, which clearly pointed to fatal results; but up to the 28th July, the railroad had enjoyed a monopoly of accidents, which had been of such frequency as apparently to justify some of our daily papers in keeping the heading, "Accident on the Hudson River Railroad," and similar ones for the Erie and the New Haven roads, in stereotype form. But on the day above mentioned, the steamboat *Henry Clay* was burned on the river, and the event being attended with such a fearful loss of life, as to draw much more than the usual attention to the circumstances, the result has been, to show a want of attention to the safety of the passengers, both in the planning and the management of the boat, which is as disgraceful as it is surprising. The circumstances, as we gather them from the evidence given at the Coroner's inquest, are as follows:—It appears that the *Henry Clay*, which was built to be the "crack" boat, started from Albany at the same time with the *Armenia*, a slower boat, and it soon became evident to those on board, that strong endeavors were made to get and maintain the lead, each of the boats, in turn, passing landings, where the other was engaged in discharging and taking passengers. At length, in a narrow channel of the river, the boats came in contact, not in such a way as to do any great damage, but exciting serious alarm among the passengers, which were crowded upon the *Henry Clay*. To their remonstrances, the officers of the boat, (the Captain, it appears, was sick, and in his state-room,) answered indifferently and impertinently, or answered not at all. The effect of the collision, however, was to cause the *Armenia* to drop astern, and the *Henry Clay* then took and maintained the lead, increasing the distance between them, until about 15 minutes past 3 o'clock, P. M., when the boat was discovered to be on fire, and a feeble and ineffectual attempt having been made to extinguish the fire, the boat was run ashore, below the village of Yonkers, and such of the passengers as could, escaped. After the alarm of fire was given, it does not appear that any effort whatever was made on the part of any officer of the boat to protect the lives of the passengers, or to give any orders by which the panic, so natural on such an occasion, might be avoided or allayed. The fire appears to have originated in the furnace-room, which

is amidships in the hold, and the dense smoke and intense heat soon cut off all communication between the forward and after parts of the boat. The greater part of the passengers, especially the women and children, were, as usual, aft, and the boat being run ashore bows on, (apparently for the especial benefit of the officers, who were in that part of the boat,) those in the rear of the engine were at a distance of some two hundred feet from the shore, and were obliged to commit themselves to the water, which is here deep almost to the very shore, many of them keeping on the wreck until absolutely forced over by the approach of the fire, which burned very rapidly. In this lamentable way, not less than eighty-one persons met their death. The occurrence of the accident on a favorite boat, and in the height of the traveling season, caused its immediate effects to be widely spread throughout our land, and increased the severity of the loss by the destruction of many most valuable lives; among which we especially grieve to record those of Mr. Downing and Mrs. Anne Hill. The loss of these will be more deeply felt, since they have left no one to succeed them in the lines of usefulness to which they had devoted themselves. Mr. Downing's reputation as a landscape gardener was known as well in Europe as here; his labors at Washington and in the vicinity of New York, by introducing a correct taste for the beauties of natural scenery, were invaluable to us, especially because they were directed to the production of results in which we have been heretofore sadly deficient. The same thing is true of Mrs. Hill, who was the Principal of the School of Design for Women, attached to the Franklin Institute. Her sex, her modesty, and the comparatively narrow sphere of her labors, prevented her from being so widely known; but the combination of so many talents, such energy and zeal, with all those virtues and delicacy which characterize a woman, ensured to her the warmest feelings of respect and attachment from those whose good fortune it was to know her. Like Mr. Downing, her tastes led her to the cultivation of arts to which heretofore but little attention has been paid among us, and her loss has left a vacancy which cannot for a long time be filled. The pain at losing such friends is aggravated by the reflection, that they were victims to the recklessness and incapacity of those whose duty it was to sacrifice, if necessary, their own lives for the preservation of their passengers; but we hope that the deep and wide-spread grief will prevent the public indignation from being as ephemeral as is usual in such cases.

As to the immediate cause of the accident, with which the majority of our readers will perhaps think we have most to do, there are many conjectures. It does not appear that any extraordinary effort on the part of the *Henry Clay* was necessary to outstrip the *Armenia;* and it is stated that the time of her trip from Albany gives an average speed of but 16 miles an hour, which is certainly far below her powers. But several of the passengers testified before the Coroner to the unusual heat about her engines, and to peculiar odors, as if from burning highly combustible materials, in the earlier part of the trip. The most probable suggestion which we have heard is as follows: It seems that it is customary with North River boats, on their downward trips, to feed their furnaces off Yonkers for the last time. The furnaces of the *Henry Clay* are in the hold of the vessel, and not on the guards, as usual. The use of anthracite as

fuel requires the blower, and it appears to be well known that when the blast is turned in, it is very apt to force open the fire doors, unless they are very carefully secured. If then we suppose that the fireman had not securely fastened the door after firing, and that the blast drove it open, we should have a powerful jet of flame poured out, as from a gigantic blow-pipe, on the wood work of the fire room, which from continual roasting is very combustible, and the light frame of the boat would catch and burn with almost incalculable rapidity. Such appears to us the most plausible account of the origin of the fire.

In connexion with the presence of one of the owners on board the boat, we give a singular statement from a newspaper, of what has since occurred on the same river. On this occasion there was a race and a collision, and one of the passengers having remonstrated with the Captain thereupon, the Captain told him that *he could not help it; that the son of the owner was on board, and was with the pilot; and that he* (the Captain) *had no authority to direct.* This statement seems to have attracted no notice, but it is really deserving of it, for if true, it points out a state of affairs which would render steamboat traveling almost suicidal.

On the 20th of August, the steamer *Atlantic*, from Buffalo to Detroit, with about 110 cabin passengers, and 270 deck and steerage passengers, and a crew of about 40 men, when off Long Point, (Canada,) and about four miles from the Light House, at 2½ o'clock, A. M., was run into by the propeller *Ogdensburg*, and sank in about fifteen minutes. The loss of life is uncertain, but is estimated at about 200. In consequence of the coolness and presence of mind of the officers, and an efficient provision of life-preserving furniture, the principal portion of the cabin passengers were saved. But the mass of the steerage passengers were Norwegian emigrants, unable to understand what was said to them, and among these the loss of life was fearful. The investigation of the Coroner's jury shews that the lights of the steamer were seen by the watch on board the propeller in time to avoid the accident, and inculpates the mate of the *Ogdensburg*, who will probably be arrested and tried, when we shall report the facts of the case, so far as they are developed.

On Saturday, the 4th of September, the *Reindeer*, another crack North River boat, (which it is said the *Henry Clay* was built expressly to beat, and which had been withdrawn during that unfortunate boat's short life, and returned to her usual trips since her destruction,) burst her boiler as she started from Kingston Point. The part which gave way was the connexion of the return flues, and by the escape of steam 32 persons were killed, and a large number badly scalded. The testimony before the Coroner's jury, shews one of those defects in the iron, which the most careful inspection cannot avoid, and the phenomena of the explosion do not require us to believe that there was any undue pressure of steam in the boiler. The occurrence of the accident immediately after starting the boat, looks as though there were a deficiency of water in the boiler, but the testimony on this point is strong to the contrary. Among the victims of this accident, we regret to record the name of Mr. Woods Baker, an assistant on the Coast Survey, a young gentleman who had distinguished himself by high abilities and zeal in performing his duties, while his amiable character

had endeared him to his many friends. It is a somewhat strange coincidence, that he should have perished in a way so similar to that by which his intimate friend and associate, Mr. Joel B. Reynolds, lost his life, by the explosion of the boiler at Morris' foundry in this City.

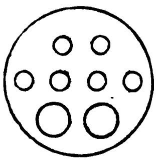
We shall publish the law recently passed by Congress, for the regulation of steamboats, and sincerely trust that its strict enforcement may prevent the necessity of such painful records in future.

EDITOR.

Since writing the above, we have received the following private letter from a friend, who is an entirely competent judge of the matter:

"Though competent witnesses have testified to their belief that the accident was due to defective iron, yet I am persuaded, from what I myself saw, that the true cause of the explosion was probably low water and heated internal flues.

There were six large internal return flues, each about a foot in diameter, and arranged thus:



The diameter of the boiler appeared to me to be not more than eight feet, perhaps less. The depth of water over the two upper flues must have been at all times slight, perhaps not more than two or three inches. It appears highly probable, therefore, that the gauge cocks may have given deceptive results, owing to foam; that the water level fell below the tops of the flues; and, therefore, the explosion while the boat remained at the wharf—the defective iron giving way because it was the weakest point."

## *Electric Property of Flame.* By Prof. H. BUFF.*

The following conclusions are drawn from the experiments described by Prof. Buff:

1. Gaseous bodies which have been rendered conductible by strong heating, are capable of exciting other conductors, solid as well as gaseous, electrically.

2. When a thermo-electric circuit is formed of air, hydrogen, or carburetted hydrogen, alcohol vapor, charcoal, or finally a metal, whether combustible or incombustible, an electric current is developed, which proceeds from the hottest place of contact through the air to the less warm place.

3. The development of electricity which has been observed in process of combustion, and particularly in flame, is due to thermo-electric excitation, and stands in no immediate connexion with the chemical process.

4. The products of combustion do not therefore by any means occupy the relation to the burning body which has been assumed by Pouillet; if positive electricity rises with the ascending gases, it is only in the degree in which the burning body and the air exterior to the place of combustion, or rather exterior to the place of hottest contact, are connected by a proper conductor.—*Annalen der Chemie und Pharm.*, vol. lxxx. s. 1.

* From the Lond., Edinb., and Dublin Philosoph. Magazine, February, 1852.

### *On the Manufacture of Gas from Wood.* By Dr. Pettenkofer.*

Two years ago, Dr. Pettenkofer showed by experiment, at a meeting of the Polytechnic Institute of Bavaria, that a very considerable amount of illuminating gas could be disengaged from 2 oz. of wood. Its practicability on a large scale has since been the subject of much doubt. The inventor's process is now in operation at Basle, and it is also about to be introduced at Zurich, Stockholm, and Drontheim. The process is said to be far less expensive than the manufacture from fossil-coal, and furnishes a gas which is free from sulphuretted hydrogen, and several useful collateral products, as charcoal, wood-tar, and wood-vinegar.—*Central Blatt., March* 10, 1852.

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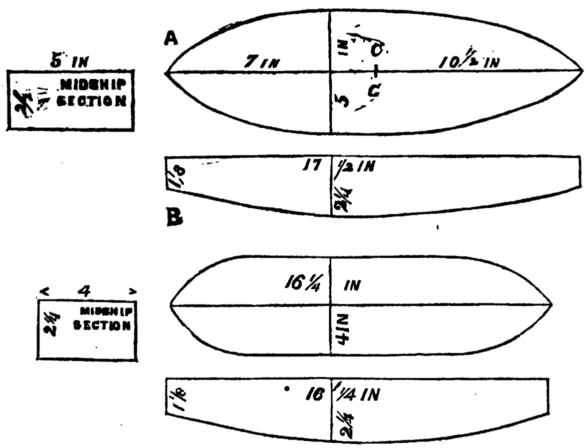
### *Hints on the Principles which should regulate the Forms of Boats and Ships; derived from original Experiments. By* Mr. William Bland, *of Sittingbourne, Kent.*†

Continued from page 182.

Having terminated the experiments relating to the midship section, and lee-way or lateral resistance, it will not be departing from the subject in view, to introduce in this place a few examples of floating bodies varied in their dimensions, and comparing their respective speeds.

*First.*

Diagram A, a boat, 5 inches wide, 17½ inches long, having curvilinear sides; weight, 25 oz.; compared in speed with B, a boat 4 inches wide, 16¼ inches long, with parallel sides; weight, 25 oz. Both these boats had their bottoms curved upwards from their midship sections to their load water lines.




*Experiment* 63.—The boat A, beat B, in speed by 6 oz. additional

* From the London Chemical Gazette, May, 1852.

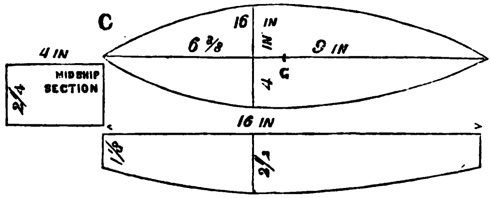
† From the London Civil Engineer and Architect's Journal, October, 1851.

weight: that is to say, to cause the speed of both to be equal under the same drawing force. The stability of A, equalled 5 oz.; that of B, 3 oz.

*Second.*

*Experiment* 64.—The boat A, compared in speed with a boat C, after the form of a bird, being 4 inches wide at midship, 16 inches long, having its bottom curved up the same as A, and of equal weight, being 25 oz. The boats, A and C, were equal in speed. The stability of A equalled 5 oz.; that of C, 2 oz.

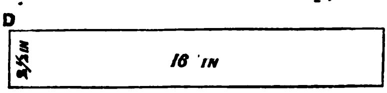
*Experiment.* 65.—But when C had the angles between the bottom and




sides removed and smoothed down, C then beat A by 4 oz. extra weight. But the stability was, in consequence, reduced from 2 oz. to 1¾ oz.

*Third.*

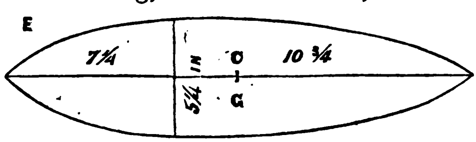
*Experiment* 66.—The boat C, was compared in speed with a boat of the precise form, but with the bottom not cut up, being left flat as in the




diagram, D. The weights equal, and being in this instance 22 oz. The boat C, beat D, by 12 oz. extra weight. Stability of C equalled 2 oz.; and that of D, 2 oz.

*Fourth.*

*Experiment* 67.—The boat A, was tested in speed with a boat E, 5¼ inches wide, 18 inches long, with curved sides, and bottom curved the



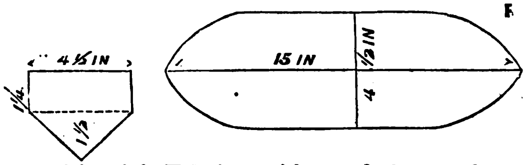

same as A. Their weights being first made to correspond, the trial upon the water gave their speeds equal. The stability of E, was 5¼ oz.

*Experiment* 68.—Upon the removal of the lower angles of the boat E, and making all smooth, its speed was improved 4 oz., so that it beat A, by the sum of 4 oz.

*Fifth.*

*Experiment* 69.—The parallel sided boat B, being tested against a parallel sided boat F, with triangular form of midship section, in width 4½ inches, and in length 15 inches, with the weight of each 21½ oz.; the form of bows the same. Being attached to the two arms of the balance rod, and drawn through the water, the result gave 4 oz. in favor of B;

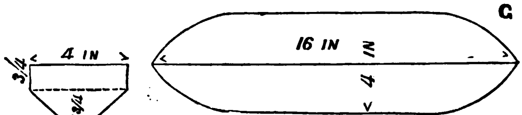
that is, the additional weight of 4 oz. was put into B, which then rendered their speeds equal.




This was not a fair trial, F being wider and shorter than B. The stability of F, equalled $2\frac{1}{2}$ oz.

*Sixth.*

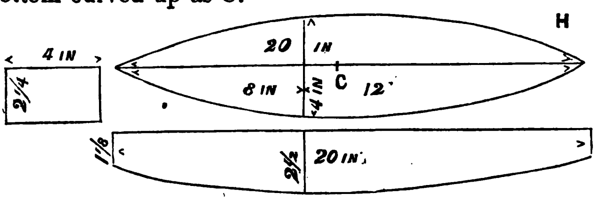
*Experiment* 70.—The boat B, was again tested with another boat, G, the midship section being a triangle; the length and breadth the same as B, and weight equal, being $21\frac{1}{2}$ oz., and having the bows of the same form.




The trial gave 8 oz. in favor of B, since the superior speed of B required that weight extra to retard it to an equality with G. The stability of G, equalled $1\frac{1}{4}$ oz. The boat B, drew $\frac{7}{8}$-inch water at midship; F, drew $\frac{3}{4}$-inch; and G, drew $\frac{7}{8}$-inch; the respective weight of each being the same.

*Seventh.*

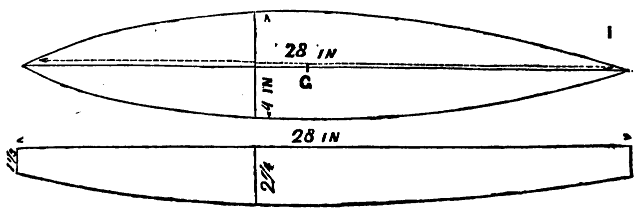
*Experiment* 71.—The boat C, being compared in speed with a boat H, of the same weight, and width of 4 inches; but in length 20 inches, having the bottom curved up as C.




The boat H, beat the boat C, by 12 oz.; H, requiring that additional weight to equalize their speed. The stability of H, was $2\frac{1}{4}$ oz.

*Eighth.*

*Experiment* 72.—The boat H, was compared in speed with a boat I,




of the same weight, namely, 33 oz., and width of 4 inches, but 28 inches long, having the bottom curved as H.

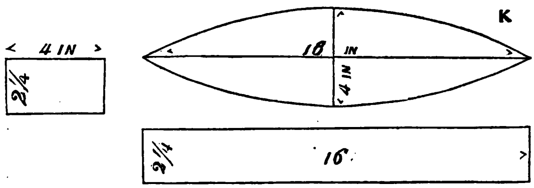
The trial gave the speed on the side of the boat I, and equal in weight to 24 oz. extra. The stability of I, was $2\frac{1}{4}$ oz.

*Ninth.*

*Experiment* 73.—The boat I, beat the boat E, before the angles were removed, by 32 oz. The stability of I, was $2\frac{1}{2}$ oz., and that of E, $5\frac{1}{4}$ oz.

*Tenth.*

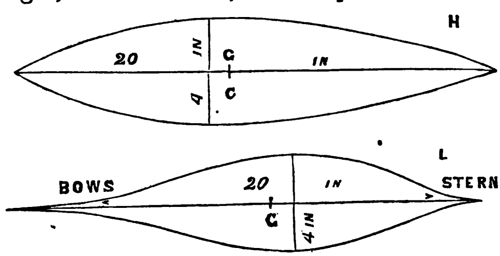
*Experiment* 74.—A boat K, 4 inches wide, and 16 inches long, having the midship section at the point of half its length, with the bows and stern alike, was tested against the boat C, but with bottom not curved up. The weight of each $20\frac{1}{2}$ oz.




The boat K, beat in speed the boat C, by 2 oz., but its course through the water was much inferior to C; therefore, a piece of keel was necessary to remedy the evil. The stability of K, equalled $2\frac{1}{4}$ oz., that of C, 2 oz.

*Eleventh.*

*Experiment* 75.—The bird-shaped boat, H, being 20 inches long, and 4 inches wide, but not curved at the bottom towards each end, being quite straight, was tested against a boat of the form marked L; the length, width, and weight, the same as H, which equalled 22 oz.




The trial of these two boats gave the speed on the side of H, with its bottom not curved, and to the amount of 4 oz. in extra weight, when the boat L, was drawn with its stern foremost; but when tested with its bows foremost, no difference was perceptible between them in speed. The stability of H, was $2\frac{1}{4}$ oz.; that of L, $1\frac{1}{4}$ oz.

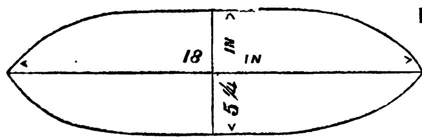
*Experiment* 76.—On comparing the speed of H, with its bottom curved up, with the boat L, the difference was 12 oz. on the side of H, it being so far superior to L.

*Twelfth.*

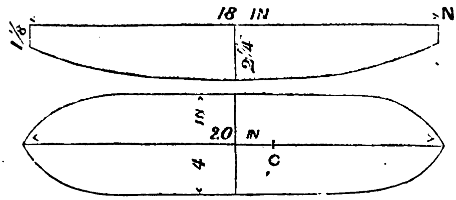
*Experiment* 77.—Two boats, one of them, M, after the form of E, being 18 inches long, a trifle more than $5\frac{1}{4}$ inches wide, and which width was in this instance situated at the mid-length, with the bottom curved up to

the load-water line, commencing from the middle length, and terminating at each extremity; weight, $2\frac{1}{2}$ lbs. The other boat, N, 20 inches long,

M




and a trifle more than 4 inches wide, sides parallel, but the bows the same in both, weight equal to M. This boat was also curved up from the mid length to each extremity.



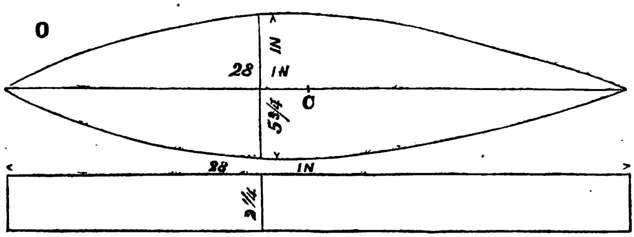

The result, upon trial, gave the speed 3 oz. superior on the side of M. The stability of M, equalled 6 oz.; that of N, 4 oz.

*Experiment* 78.—When the boat H was tested with the parallel sided boat N, their respective weights being 2 lb. 7 oz., the boat H, beat the boat N, in speed by the extra weight of 16 oz. The stability of H, equalled $2\frac{1}{4}$ oz.; that of N, 4 oz.

*Thirteenth.*

*Experiment* 79.—A boat O, of the bird shape, $5\frac{3}{4}$ inches wide, 28 inches long, weight, 2 lb. 5 oz., was tested in its speed against a boat also of the bird shape, 4 inches wide, 28 inches long; weight, 2 lb. 5 oz., and denoted in the preceding diagrams by the letter I. I, sank in the water $\frac{15}{16}$-inch, and O sank $\frac{11}{16}$-inch.

O

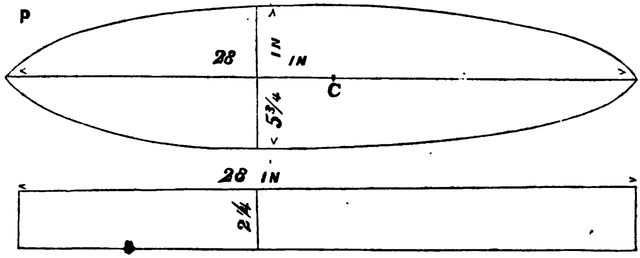



The result gave the speed on the side of I, in the extra weight of 12 oz. The stability of O, was 8 oz.; that of I, $2\frac{1}{4}$ oz.

*Fourteenth.*

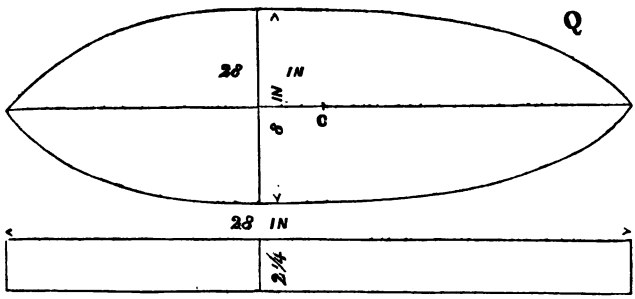
*Experiment* 80.—The boat O, was tested with a boat P, of a different form, but of the same width of $5\frac{3}{4}$ inches, 28 inches long; and weight of each, 3 lb. 4 oz. O, sank in the water $\frac{15}{16}$-inch; and P sank $\frac{3}{4}$-inch.

The boat O beat P, by 2 lb. 5 oz. extra weight. The stability of O, equalled 8½ oz.; that of P, 12 oz.




*Fifteenth.*

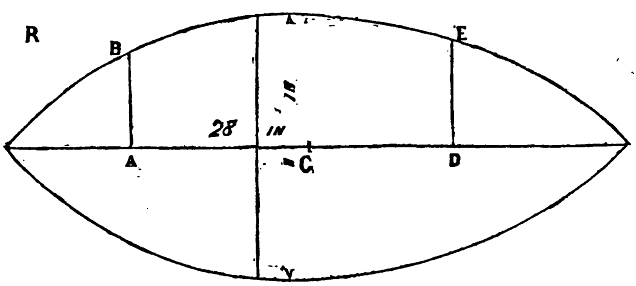
*Experiment* 81.—The boat P was tested against the boat Q, being 8 inches wide, 28 inches long, and weight of each, 3 lb. 4 oz. P, sank in the water $\frac{6}{8}$-inch; and Q sank $\frac{5}{8}$th-inch.




The boat P beat Q, by 20 oz. extra weight. The stability of P equalled 12 oz.; that of Q, 24 oz.

*Sixteenth.*

*Experiment* 82.—The boat Q was tested against the boat R, being 11 inches wide, 28 inches long, of the bird or duck shape, each weighing 5 lb. 1 oz. Q sank in the water $\frac{13}{16}$-inch; and R sank $\frac{13}{16}$-inch.




The boat Q beat the boat R, by 4 oz. extra weight. The stability of Q was 25 oz.; that of R, 29 oz.

*Seventeenth.*

*Experiment* 83.—The boat Q was again tested with a boat T, of similar dimensions, being 8 inches wide, 28 inches long, but each weighing 4 lb. 6 oz. Q sank in the water $\frac{13}{16}$-inch; and T sank $\frac{7}{8}$-inch.

The boat T beat the boat Q in speed, by 32 oz. extra weight. The stability of T equalled 16 oz.; that of Q, 24 oz.

*Experiment* 84.—This experiment was made to ascertain the law of the density of water with respect to bodies floating upon its surface, and the displacement they occasion. A tin vessel of a square form, and measuring 4 inches cube, was put on the water; and having first noted the displacement by its own weight, 2 oz. were then put into it, when their displacement was carefully marked upon one of the sides of the vessel. Another 2 oz. being added, the displacement was again marked; and so on to a third, &c., &c., up to 16 oz., altogether making, in the whole, eight divisions. Upon measuring the several divisions recorded, they were found all equal; consequently, showing that equal weights caused equal displacements.

(To be continued.)

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## *On a New Mode of Measuring High Temperatures.* By Mr. John Wilson, of Bridgewater.*

After referring to and describing briefly the pyrometers at present in use, the paper explained the method employed by the author to measure high temperatures. According to his plan, a given weight of platinum is exposed for a few minutes to the fire, the temperature of which is required to be measured, and then plunged into a vessel containing water of a determined weight and temperature. After the heat of the platinum has been communicated to the water, the temperature of the water is ascertained; and from this is estimated the temperature to which the platinum was subjected. Thus, if the piece of platinum employed be 1000 grains, and the water into which it is plunged be 2000 grains, and its temperature 60°, should the heated platinum when dropped into the water raise its temperature to 90°, then $90°—60°=30°$; which, multiplied by 2, (because the water is twice the weight of the platinum,) gives 60°, that an equal weight of water would have been raised. Again: should the water in another case gain 40°, then $40°\times2=80°$, the temperature measured by the pyrometer. To convert the degrees of this instrument into degrees of Fahrenheit, we must multiply by 31·25, or $31\frac{1}{4}$. Thus, $80°\times31\frac{1}{4}$, would give 2500° of Fahrenheit. And $60°\times31\frac{1}{4}=1875°$. The multiplier 31·25 is the number expressing the specific heat of water as compared with that of platinum—the latter being regarded as 1.

In order to attain very accurate results by this method, precautions similar to those required in determining the specific heat of bodies must be taken; that is, it is necessary to guard against the dissipation of heat by conduction and radiation. The apparatus used by the author consists of a polished tinned iron vessel, of a cylindrical form, 3 inches deep and 2 inches in diameter; this is placed within a concentric cylinder, separated from the enclosed vessel about $\frac{1}{4}$-inch. By this means there is but little heat lost during the experiment, either by radiation or conduction.

At the commencement of the experiments, the author imagined it would be necessary to employ a considerable proportion of water, and

* From the London Journal of Arts and Sciences, July, 1852.

therefore took 25 times the weight of the platinum; but he found that the temperature gained by the water, even in cases of very high heats, did not exceed 4° or 5°—and an error of 1°, when converted into degrees of Fahrenheit, amounted to 400°. To obtain results within much narrower limits of error, it became obvious, a much smaller proportion of water should be employed; and ultimately it was found that double the weight of the platinum was in all cases sufficient.

There is no appreciable loss of heat from the evaporation of steam when the hot platinum is plunged into the water; there is probably no actual contact with the water until the platinum is fairly at the bottom of the water. It is in fact the converse of dropping water on a plate of platinum or iron strongly heated; in which case the water, instead of being suddenly dissipated as steam, assumes the spheroidal form, and runs about over the plate without coming in contact with the heated surface. It is only when the temperature of the metal becomes much reduced that the water is rapidly converted into vapor.

In ascertaining temperatures by this pyrometer, a correction has to be made for the portion of the total heat that is absorbed by, 1st, the mercury of the thermometer in the water; 2d, the glass bulb and stem of the thermometer; 3d, the iron vessel containing the water; 4th, the heat retained by the piece of platinum.

The portion of the total heat that is absorbed by these several bodies, compared to the portion received by the water, will be in proportion to their several weights, and the specific heat of each compared with water.

| | | | | | Equivalent grains of water. |
|---|---|---|---|---|---|
| Mercury, | 200 grains | × $\frac{1}{30}$th | specific heat = | | 7 |
| Glass, | 35 " | × $\frac{1}{6}$th | " | | 6 |
| Iron, | 658 " | × $\frac{1}{9}$th | " | | 73 |
| Platinum, | 1000 " | × $\frac{1}{32}$d | " | | 31 |
| Total, | . . . . . . . . . | | | | 117 |

Therefore the effect of these bodies is equivalent to the addition of 117 grains to the 2000 grains of water,—or $\frac{1}{17}$th has to be added as a correction to all the temperatures obtained by this instrument; or, in other words, the multiplier must be increased from 31¼ to 33 in this instrument, and in all similar ones where the weights of the mercury and glass of the thermometer, and of the iron vessel, are the same as stated above.

As the piece of platinum is the most expensive part of the apparatus, it is proposed to use a small piece of baked Stourbridge clay as a substitute for the platinum. The author has found, by experiment, that a piece of Stourbridge clay, 200 grains in weight, when heated to the melting point of silver, and plunged into the tinned vessel containing 2000 grains of water, raises the temperature of the water, 41°.

Now, if 1890° Fahrenheit (the melting point of silver) be divided by 41, we obtain 46° as the number corresponding to 1° of this pyrometer; and 46 will therefore be the correct multiplier; and no corrections are required for any heat abstracted by the thermometer, the tinned vessel, or the piece of clay.

The temperature of all sorts of furnaces and flues of steam engines, &c., may be readily ascertained by means of the piece of Stourbridge clay.

The chairman expressed the interest he felt in this new pyrometer that had been brought before the meeting, and considered it an ingenious and efficient instrument. He remembered having had a conversation with the late Prof. Daniell on the subject of his pyrometer, and expressing a doubt of the nearness of the approximation in the results obtained from that instrument; in fact, such delicate manipulation was required in using it, that it was scarcely available except in the hands of the inventor himself. But Mr. Wilson's instrument was so extremely simple in the construction and practical application, that an accurate measure of the quantity of heat could be relied upon, with ordinary care in the employment of the instrument. It might be theoretically considered, that quantity of heat was a different point from intensity of heat,—as in the case of voltaic electricity the difference between quantity and intensity was known to be so strongly marked in the different effects produced; and this pyrometer, although measuring correctly the relative quantity of heat required to melt different bodies, might give far from a correct measure of the relative intensity of different fires. However, the same theoretical question applied of course to the ordinary mercurial thermometer, which was also the standard of measure in this pyrometer, and to all thermometers which measured the degree of heat by the relative expansion of any body by heat, whether mercury, iron, or air.—*Proc. Mech. Eng.*, *Birmingham.*

Remarks.—We do not doubt that for practical purposes, the very neat and simple process proposed by Mr. Wilson will be found very convenient and valuable; but for scientific accuracy, the loose establishment of equivalents will not answer, nor can the instrument be relied upon for delicate determinations, until the specific heat of platina at high temperatures shall have been determined; at present it is simply unknown. The pyrometer, invented by Prof. W. R. Johnson, used in the experiments on the explosions of steam boilers, by the committee of the Franklin Institute, and described in the *American Journal of Sciences*, vol. xxii, p. 96, and Report of the Committee, part II, p. 16, is analogous in principle, but far less convenient in practice. Ed.

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## FRANKLIN INSTITUTE.

*Proceedings of the Stated Monthly Meeting, September* 16, 1852.

Samuel V. Merrick, Esq., President.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

A communication was read from the Metropolitan Mechanics' Institute of Washington, D. C., informing the Institute of their organization, accompanied by a copy of their Constitution and By-Laws.

Donations were received from Messrs. A. S. Barnes & Co., New York; The U. S. Light House Board; Hon. Joseph R. Chandler, U. S. Congress; J. Amery, Esq., Boston; Messrs. John F. Frazer, Richard B. Osborne, W. H. C. Riggs, Charles E. Smith, J. A. Kirkpatrick, and the Pennsylvania Railroad Company, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of July.

The Board of Managers and Standing Committees reported their minutes.

New candidates for membership in the Institute (12) were proposed, and the candidates (13) proposed at the last meeting were duly elected.

On motion, it was

*Resolved*, That the Franklin Institute see with great pleasure the formation of a new Association for the promotion of Manufactures and the Mechanic and Useful Arts, in the City of Washington, and that they will do every thing in their power to promote its ends.

*Resolved*, That the Corresponding Secretary be directed to communicate this resolution to the Metropolitan Mechanics' Institute.

Dr. Rand, Chairman of the Committee on Meetings, presented to the meeting a model of an improvement in Carriage Axles, invented and patented by the Rev. Kingston Goddard, of this City. The nature of this invention consists in making the box in two or more parts, with a recess to receive and embrace a collar on the journal part of the axle, or what is essentially the same, with a projecting fillet to fit into a recess in the journal part of the axle, when this is combined with the mode of securing and holding the box on the axle, by making its periphery conical, to fit and be drawn into the hub, or into a pipe-box fitted to the hub, so that by simply securing the box within the hub or pipe-box, the axle is at the same time secured within the box. The advantages claimed for this arrangement are to be found in the ease and regularity of motion produced, the perfect safety of the apparatus, its retention of oil, with facility of cleaning and repair.

Dr. Rand also exhibited a piston of a steam cylinder, which had been received from Mr. M. W. Baldwin, and which was so much corroded as to be ruined by the action of rosin oil, which had been used upon it as a lubric. Dr. R. remarked, that in preparing this oil by the destructive distillation of rosin, a large amount of pyroligneous acid was formed, and it was undoubtedly to this that the corrosion was to be attributed. Mr. Greble had informed him, however, that he had used a rosin oil on a large shaft running through a cellar, and had found that it did not gum, nor corrode the metal, while it remained fluid at temperatures at which other oils became stiff. The difference in the oils was due to the care used in their preparation, and the pains taken to separate completely the pyroligneous acid.

Dr. Rand called the attention of the members to the interesting results of some experiments on the strength of sheet iron and copper, made by Mr. Joseph Harrison, Jr. The sheets were confined between two hemispheres, into the lower of which water was forced; the deflection was measured by means of a rod passing out through the upper one. A sheet of copper, full $\frac{1}{32}$-inch thick, at 532 pounds to the square inch, was not bursted, but had assumed an uniformly dome-shaped form, as perfectly as if stamped with a die, and was much drawn at the bolt holes; the deflection in the centre was $2\frac{1}{20}$ inches. A sheet of Russia sheet iron, $\frac{1}{32}$-inch scant, at $84\frac{1}{2}$ pounds became also dome-shaped, and burst at a flaw

nearly midway between the centre and circumference, the deflection at the centre being $\frac{3}{4}$ of an inch full.

Mr. James Young, Printer, of Philadelphia, exhibited an Anti-Friction, Self-Acting Press, for book, job, and card printing, and made the following remarks upon it:

This press is anti-friction in the same sense as Dick's anti-friction press, and self-acting in the same sense as the self-acting cotton mule. Its advantages generally over any other press consist in its greater power, better adaptation of the lines and position of the metal to bear greater strain, with a less weight of metal in the whole machine than any that has yet appeared for type printing. It is simpler in construction, having fewer pieces than a hand press with rolling or inking apparatus attached; it has a "throw-off" so constructed as to throw off the impression at the last moment before actually giving the pressure; it has also an improvement in distributing the ink, and of self-action in unfastening and fastening the form solidly in a moment, without screws or wedges. The sheets can be fed on the press at any desired angle between 45° and a horizontal line; the pressure on the nippers that hold the sheet can be regulated at will. A further description and engraving of the press will be given when patents have been secured in Europe.

Mr. Aldritch Moore exhibited A. S. Macomber's Patent Feed Cutter. In this machine the frame that holds the knife is of cast iron, and is fastened to the front posts by screws, with a projection for boxes, in which the ends of the cylinders are placed. There is also another projection, with a mortise, into which the knife is placed, and confined by means of screws at both ends; there is also a screw at each end of the back of the knife, intended not only to hold the knife from moving back, but also to move it forward as it wears. The cylinders are of cast iron, with spiral flanches of any desired number. The cylinders are so placed that the flanches of the upper will play as near the centre of interval between the flanches of the lower as possible. The flanches, when revolving, act as feeders, and draw the article to be cut in contact with the edge of the knife, where it is cut. The knife may be sharpened by placing a little emery and oil on the flanches, and turning the machine back, the knife being at the same time started forward by the set screws, This machine claims the advantages of greater simplicity and ease of operation; having but a single straight knife, it is easily kept in order. It has been applied for cutting paper and rags, as well as feed, and has been found to answer admirably.

Dr. Kennedy called the attention of the meeting to an improved Ear-piece for Acoustic tubes. These tubes, by which communication is maintained between different apartments in hotels, factories, stores, offices, &c., were coming into very general use, and were even supplanting the door and servant bells in dwellings. Formerly, it had been necessary to put up a line of bell-wire with bell attached, parallel with the tubes, to call the attention of the individual addressed; such had been the arrangement in the late Barnum's Museum in this City. Messrs. Woolcocks & Ostrander, of New York, have removed all necessity for a bell, by placing a whistle in the ear-piece, which utters a shrill sound whenever the tube is blown through from the other end, and thus warns the hearer. The whistle

blocks up the bore of the ear-piece, wherein it is kept by a spring, and from which it may be displaced by depressing a small lever on the outside, leaving the calibre free for conversation. A small hinge-valve, which covers a lateral orifice in the ear-piece, is thrown up by the force of the breath in whistling, and remaining elevated, gives further assurance that a hearing is demanded. The expense of these tubes is but little if any greater than bell hanging. The articles exhibited came from Mr. T. Butler, tin and copper smith, Seventh street, a few doors from the Institute, who would furnish tube at $3 per 100 feet, and patent ear and mouth-pieces at from $2 to $2·50 the pair.

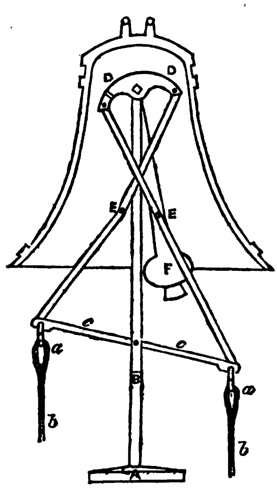
Dr. Kennedy also exhibited specimens of French Enamellèd Ware, from the house of M. Engler, 128 Rue Vieille du Temple, Paris. The enamel covered the inner and outer surfaces of the iron vessels, which were not cast, but stamped. Stamped vessels of tinned and of enamelled iron were stated to be in common use in France, where they were fast taking the place of the ordinary grooved and soldered tin-ware. The absence of sharp angles and crevices, which retain dirt, gave the former a great advantage on the score of cleanliness. Dr. Kennedy further said, that the business of enamelling iron was fast assuming importance on the Continent. He had seen in the National Porcelain Manufactory at Sevres, near Paris, vessels fashioned of iron, covered with porcelain, and most elaborately ornamented. The expense of enamelled culinary articles was but slight; he had bought at the establishment above mentioned an iron saucepan of the capacity of a quart, and enamelled on both sides, for 1¼ francs (about 24 cents). The saucepan was so thin that it could be heated over a spirit-lamp like an evaporating basin, and had been used in his laboratory for several months, subjected to the action of acids and fatty matters, without perceptible injury to the enamelling. Signs perfectly indestructible by ordinary wear and tear are made of enamelled iron. These are frequently seen on the mile posts and *grade indicators* of European railroads; also at the corners of the streets of cities, bearing the names of the streets. A street sign, about 25 inches (63 centimetres) long, with a row of three-inch letters, is furnished at five francs. Breast-pins, plant labels, tomb tablets, and a host of other articles of beauty or utility, are cheaply supplied by the skill of the French enamellers.

A Dioptric Apparatus of Fresnel, of the first order, furnished with a cupola and lower zones of catadioptric rings, made by Le Paute, of Paris, for the light-house on Carysford reef, Florida, had been put together under the direction of Lieut. George Meade, of the corps of the United States Topographical Engineers, and the members of the Institute were kindly permitted by him to view it. The eight panels of the central belt consist of four annular lenses and four cylindrical elements, which revolve around the light in the focus as a centre, presenting the vertical bar of light which characterizes the fixed light visible in every azimuth, the annular lenses interrupting in their revolution the *central portion* of this beam of light, and concentrating it in one great flash of intense brilliancy. By the revolution of the central belt, a single annular lense in it produces a similar, and even a better effect, than the vertical cylindrical element revolving around the drum of the fixed light apparatus heretofore in use. It is, moreover, more simple, less weighty, and intercepts less light,

inasmuch as one lense is substituted for two. It was explained to the meeting by G. W. Smith, Esq. The four wick lamps, he stated, were expensive, complicated, and occasionally, though very rarely, liable to derangement, and required some skill to repair them. In England, the mechanical lamps have been superseded by a common fountain or vessel of oil placed above, provided with a tube, conveying the oil to the burner; an intermediate regulating reservoir, provided with a floating ball, gives the requisite supply. In France, moderator lamps, so called, have lately in some instances been substituted; they consist of a heavy loaded piston, which is perforated, and by its pressure in descending, forces up the oil through a tube to the level of the burner, and receives the overflow on its upper surface. This lamp, however, is defective in principle, from the varying height of the column of oil, and on that account was rejected by Mr. S., who invented the same some eight years since. A piston moving horizontally in a box, the pressure being applied over a pulley by a weight descending vertically, will of course sustain a column of uniform height, and therefore of uniform resistance; this plan of Mr. S's., he deemed preferable to the moderator, but still he thought the fountain to be superior to either for light-house lamps, although his arrangement of the horizontal piston is very suitable for domestic lamps.

Mr. S. proceeded to state that a careful examination of the screw pile light-house, on the Brandywine Shoal in the Delaware Bay, had shown that it had successfully resisted the ice of the last three years without sustaining injury, and last winter it was repeatedly assailed by vast masses; he was happy also to inform the meeting, that the iron pile light-house on Carysford Reef, had resisted all the storms since its erection, and especially the late tremendous hurricane.

Mr. Thomas A. Stran, of New Albany, Indiana, exhibited to the meeting a model of his Apparatus for Ringing Bells, which will be understood by a reference to the accompanying figure.




The pedestal, A, and upright shaft, B, and lever, C C, and lever, D D, and compound lever, E E, and bell clapper, F, may all be made of cast or wrought iron, or other metal. The pedestal, A, may be made any suitable length and breadth, and fastened to a suitable beam by means of screws and bolts, to sustain the upright shaft and combined fixtures for ringing the bell. The shaft, B, is made of any length that may be desired to suit the position or situation of the bell.

The levers, C C and D D, and the compound lever, E E, must necessarily be governed in their length by the size and dimensions of the bell. The links, *a a*, are for the purpose of attaching the bell ropes, *b b*.

Mr. Stran claims for this arrangement the advantages of simplicity and cheapness. The bell being stationary, the jarring to the building is prevented; the utmost

precision in ringing can be attained with but a slight exertion of force. The bounding of the clapper is prevented, and thus one great cause of the breakage of bells avoided.

Frederick Graff, Esq., the Superintendent of the Schuylkill water works, being present, Mr. Smith stated that for eight years past, he had been engaged in examining the amount of sediment held in suspension in that water as delivered in the city; he had made in that time, nearly four thousand experiments with a porcelain cylinder, into which the water was daily poured, allowing it to remain undisturbed for a given period, and then examining the amount of sediment. The general result, which is all that he would present to the meeting, was, that the amount of deposit was much greater than was usually supposed, and that even under the most favorable circumstances, when the water was in its best condition, the deposit was always perceptible within the first six hours from the commencement of the settling, and in many cases continued to settle even for forty-eight hours. The reservoirs on Fairmount are of but limited dimensions, and cannot be used advantageously for subsidence. It will scarcely be credited in the cleanly City of Philadelphia, that these reservoirs, some of which are nearly forty years old, have never been cleansed until the present year. Mr. S. briefly described the disgusting nature of the deposit that had been removed, and the sources whence it had been derived; that in fact, the only reservoirs of subsidence were the stomachs of the citizens of Philadelphia; he was astonished that they had not long since revolted at this impurity. He described an ingeniously contrived reservoir of subsidence, devised by J. Price Wetherell, Esq., similar in principle, though larger in scale, to that used by him in his white lead factory, and regretted that his liberal offer for constructing the same had not been accepted by the Councils of the City. The Cities of New York and Boston possess great advantages over us, in the fact that their supply is not drawn from a turbid river, but from large, deep, and pellucid lakes. Mr. Graff stated that the chemical analysis showed that the water of the Schuylkill was as pure as that of the Croton, or of the Cochituate, which Mr. S. admitted, provided it was previously filtered, but not otherwise.

Mr. S. also gave an account of an apparatus for economizing the heat which is now totally lost by the use of foul air flues for ventilating rooms; the common respirator some dozen years since, gave him the first idea of recovering the heat from the warm air now uselessly expelled into the atmosphere. A box packed with metallic wire gauze in numerous parallel layers, was to be placed in the foul air flue, in which it would soon acquire the same temperature; a similar box was to be placed in the adjoining foul air flue; when the first box had acquired the necessary elevation of temperature, the effluent valve was to be closed temporarily, and the cold air from without made to pass by a similar valve through this heated box on its way to the main heating apparatus, to be still further heated. The inconvenience of this apparatus would be twofold; first, the necessity of employing machinery or attendants to work the valves by which the currents are made to alternate from one box to the other, as they are alternately hot and cold; second, the inconvenient, unpleasant, and unhealthy deposit of moisture on the cold metallic surfaces in the box, from

the effluent foul air, which moisture would be again introduced into the room on the change of the current of air; he therefore modified this plan, by the introduction of a number of pipes into the fresh air flue from without, which pipes would convey the foul air to the external atmosphere, without permitting any mixture of air to take place in the flue, and which would be sufficient in extent of surface and in number to absorb all the *available* heat of the effluent foul air; where mechanical forcing machinery is not employed, sufficient heat must be left in the air to insure its ascent, and thus to ventilate the apartment. The condensed water would be from time to time drawn off from the lower part of the tubes without mingling with the fresh air on its passage to the main heater.

Mr. Jacob D. Sheble exhibited several forms of the stereoscope, very simple, cheap, and portable, with a diaphragm, which he stated enabled persons who could not readily adjust their eyes with the ordinary stereoscope, to use them with facility. The common reflecting pseudoscope was also exhibited by him, very cheap in its construction.

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## BIBLIOGRAPHICAL NOTICES.

*The Model Architect,—containing original Designs for Cottages, Villas, Suburban Residences, &c., accompanied by Explanations, Specifications, Estimates, and elaborate details. Prepared expressly for the use of Projectors and Artizans throughout the United States.* By Samuel Sloan, Architect. Philadelphia: E. S. Jones & Co. 1852.

We have delayed reviewing this interesting publication until the completion of the first volume, now before us, as there is generally much inequality in the contents of such works, and it is necessary to examine many numbers before it is possible to form a correct opinion of their average value, and a careful examination of this work has strongly confirmed this opinion; the designs are of very unequal merit; with many of them we have been exceedingly pleased; the general arrangement of the cottages, villas, &c., is exceedingly picturesque, ornate, without meritricious adornment, and the plans combine the best modern improvements and conveniences, without the necessity of extravagant expenditure. While there is, however, much to gratify the eye, and satisfy the judgment of the architectural critic, we reluctantly perceive a few of the designs which do not manifest purity, either in their masses or details; it is true, that a certain latitude or license is allowable in private residences, where even the caprices of the proprietors are at least tolerated by the public taste; a more rigid adherence to rule is expected in urban buildings, but especially if they be public edifices. It is very difficult to draw the fine line of demarcation between commendable originality and servile adherence to precedent, an adherence which is the bane of genius, and which in its very essence, is hostile to all improvement, an incubus which forbids the genius of architecture to soar into the regions of the untried, or to display the beauties resulting from novelty and invention; yet this adherence is what

specially has characterized the architecture of the last three centuries. The architect has been compelled to walk in the same wearisome, monotonous round trodden by his predecessors, and to be trodden by his successors, if the purists are to remain in the ascendant. The decree has gone forth from them, that the fashion is to be as immutable as in the days of the Medes, and that a building is to be pronounced without the pale of fashion, and therefore of endurance, unless it be a fac simile of those that have preceded it. We read much in the æsthetic school of rigid transcendentalists, of the great and by them styled eternal principles which should govern architectural composition; it is true that a few such great principles unquestionably exist, and can be easily demonstrated, but their number is much less than the purists would wish us to believe. After all, mere fashion has nearly as much to do with architecture as with dress, furniture, and articles of virtu; and the great latitude which has been allowed in these latter, in all ages and countries, has only been less tolerated in the forms displayed by architecture from the more permanent character of the materials, and the consequent impossibility of frequent capricious changes. Nearly a thousand years ago, the Romanesque, Byzantine, and Lombardic, gratified our ancestors, wholly regardless of the classic schools of Greece and Rome; a few centuries later, the mediæval pointed began to aspire towards heaven, disdaining the low and long horizontal lines of Greece; change followed change so rapidly that scarce two buildings could be found with identically the same features, and the last expiring school of the pointed style bore but a feint resemblance to its early predecessors. The Cinque Cento and Renaissance soon superseded the pointed mediæval, which remained in a state of suspended animation until the present generation have disinterred and endeavored to resuscitate it, with what success, the majestic fane of Trinity Church, New York, towering to the skies with a grandeur and a purity as yet unsurpassed by any edifice erected in that style since the first settlement in the United States, may attest.

The ancient Roman school next attracted the universal approval of Christendom, until Stuart and Revett presented the still more ancient claims of Greece, when an eruption of pseudo Greek buildings, which would have astonished an inhabitant of Attica, began to deform, and in a few cases to beautify the civilized world. The Greek mania has now greatly subsided: the straight jacket has been removed, and edifices built mainly according to Greek principles, without a too servile adherence to their forms or details, and invested with all the improvements of a modern civilization which the Greeks never knew.

A new era at length arrived; the moderns, repressing their inventive faculties, were content, after the manner of the much ridiculed Chinese, merely to copy; and after an age or two, wearied with the monotony of one school, resorted to the scarcely less irksome task of copying another; until at length a glimpse of returning reason led them to perceive that much, if not equal beauty might be found in the schools of widely separated eras. The present taste is more cosmopolitan than in any previous age of the world. We may find in one and the same city specimens, or intended to be such, of each and all the eras which we have previously named; but all copies, with scarcely an attempt at originality; nay, we

have even seen a design by a soi-disant architect, combining them all in one and the same building—a vision doubtless revealed to him in a nightmare, and eminently calculated to produce one in the spectator. Indeed, were a building to arise, graceful in its form, harmonious in its proportions, and exquisite in all its details and accessaries, and strictly conforming to the few generally received cannons of beauty, but without an adherence to the mere conventionalities of the schools, we very much doubt, nay, we do not doubt at all, whether it would not be denounced as a monster, and its designer charged with intolerable presumption, and inordinate self conceit. In applying these remarks to the book before us, our readers may perhaps praise the very non-adherence to precedents, which Mr. Sloan has exhibited by his non-adherence to purity in some of his designs, although we must confess, that the stays of our grandmothers, and the cocked hats of our grand-fathers, as parts of the dress of one individual, seem somewhat unfashionable, even if they be not irreconcilably incongruous; we hail, however, the appearance of this, as of all similar works, for the diffusion of the knowledge of architecture among our almost untaught people. The plates are well executed, the explanatory letter-press written in a plain, agreeable style, and we trust the work will long be continued, and meet with increasing patronage.

G. W. S.

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*Blatchford's Circuit Court Reports*, Vol. I. By SAMUEL BLATCHFORD. Auburn, Derby & Miller, 1852: Philadelphia, T. & J. W. Johnson.

The above is the title of the first volume of Reports of Cases determined by Mr. Justice Nelson, with the Associate Judges Betts, Conkling, Prentiss, and Judson, in the several United States Courts for the Second Judicial Circuit, (New York, Connecticut, and Vermont.) The work is here noticed because it is deemed of great value to patentees, patent solicitors, experts, and scientific mechanics. It contains decisions of Mr. Justice Nelson upon one hundred and eleven points of patent law and practice, a more numerous and important collection of adjudications upon this branch of Law than can be found in any previous volume of Reports. The great reputation which Judge Nelson has acquired in patent cases renders the opinions contained in this volume of the highest authority. The cases here reported involve questions arising under the latest amendments of the patent laws—questions as to what constitutes patentable invention—what acts amount to an abandonment of an invention—invalidity of re-issued patents—jurisdiction of Circuit Courts over infringements committed out of their districts—evidence—account—injunction and damages, &c. An interesting opinion is also reported in a case arising under the act granting patents for designs, (the first reported case we believe under that act;) and another on the much debated question of the right of defendants to an issue or jury trial, in suits for infringement brought upon the Chancery side of the Court. The Woodworth patent, the Blanchard gun-stock patent, Allen's gun-lock patent, and Wolf's car wheel patent, are explained, commented upon, and their limits defined. The able arguments of counsel in the great case of Wilson *vs.* Rousseau,

which are omitted in Howard's report of this case, (4 Howard, 646,) are here given at length, and much interest is thereby added to the case.

It will be remembered that Mr. Justice Nelson presides over the Circuit Court in New York, where a very large proportion of all the patent cases of the country are tried. Patentees, and all persons owning or engaged in the protection of patent rights, as well as those seeking to restrain illegal encroachments on public rights, are under deep obligations to Mr. Blatchford, for thus circulating the wise, sound, and protective doctrines of Mr. Justice Nelson on this subject. The copiousness of the reports, the lucid arrangement of cases, and the complete digest contained in the index, add much to the value of the work.

We understand that the reporter has in his possession materials sufficient to enable him to publish a second volume in the course of another year. We sincerely trust that the encouragement extended to this volume will be such as to induce him to send the second to press at an early date. Messrs. T. & J. W. Johnson are the publishers in this city.

G. H.

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*Elements of Natural Philosophy.* By W. H. C. Bartlett, D. D. II. *Acoustics.* III. *Optics:* New York: A. S. Barnes & Co., 1852.

We had occasion in a former number of our Journal, to notice the appearance of the first part (Mechanics) of this work of Prof. Bartlett, and the appearance of this second volume, containing the treatise on Acoustics and Optics, has not disappointed us.

Any student who has endeavored to acquire a good knowledge of either of these subjects from the books usually accessible, will appreciate the value of a treatise, which is clear and precise in its explanations, careful in its definitions, and simple in its method, which, while it does not discard mathematical formulæ, restrains them within limits, and does not allow itself to be transformed into a mere book of exercises in transcendental algebra. The connexion between the two branches, the effects of similar causes, is very clearly maintained, and their differences and the causes of these differences lucidly shewn. The theory (especially that of sound) is very beautifully made out, and its applications to practice abundantly and well illustrated; though we think the explanation of the discordance between Newton's formula for the velocity of sound, and the results of actual experiment, might have been improved by consulting the recent papers of Cauchy, Prof. Challis, and others. The theory of music is very simple and happy, and well derived from the antecedents; and we think that if any one were to carry out the views here taken, we should hear little more of the indignant rejection by musicians of any connexion between their art and the physical sciences. The article on temperament is one of the few to be found, which are to be understood by any but a technical musician.

The treatise on Optics will also be very valuable as a text book, of which we are in very great want; the treatise of Sir David Brewster being too merely popular, while the most of the other works are rather mathematical exercises than explanations of physical phenomena.

Editor.

# JOURNAL

OF

# THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

# PROMOTION OF THE MECHANIC ARTS.

**NOVEMBER, 1852.**

## CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

*Remarks on the Application of Steam to Ships of War.* By William N. Jeffers, U. S. Navy.

The evident superiority which a steamer possesses over sailing vessels, in the navigation of the rivers and along the coasts, and, within late years, the success of extended voyages by steamships, has very naturally suggested the more extended application of steam to ships of war. The advantages of rapidity and certainty of transit, her independence of fickle winds and adverse tides, are so striking, that even the least conversant in naval affairs esteems himself competent to decide the question, and joins in the cry which denounces as "old fogyism," the expression of a doubt as to the ultimate advantages to be derived from the substitution of steam for its more economical rival.

To the present time, this asserted superiority has not been proved to exist, and it is very doubtful whether the efficiency of the navy, far less that of an individual ship, has been increased by the means already adopted.

I have been led to make these remarks, by reading in an article in the July number of this *Journal*, from the pen of a distinguished authority, (W. Fairbairn,) the following:

"Steamers can back out of difficulties and dangers, when sailing vessels must remain exposed; they can assail the enemy at a great distance, and take up any position they choose; and with their great guns and long range, inflict severe punishment, and do great execution, without receiving a single shot."

We have here in five lines five assumptions, at least four of which we think erroneous, and shall proceed to state the grounds for our opinion.

We do not pretend to deny any advantages which may be claimed for the steamer in a littoral warfare; but for that purpose celerity of motion, light draft of water, and capacity for the accommodation of large bodies of troops, are indispensable. Such enterprises are not successful by reason of any force in the steamers, but in their unexpected presence in front of the enemy, or success in clearing natural or artificial obstacles, supposed sufficient to bar their progress.

That this view of the case is a correct one, is shown by our own operations in the Gulf during the war with Mexico, and the warfare of the English in China. The vessels employed on these occasions were in no respect capable of sustaining an action with sailing ships of war, and owed their success to the weakness and unprepared state of the enemy; they were common steamboats, purchased for the occasion, and for similar occasions always to be procured at a day's notice.

But the principal duties of a navy are upon the open sea; engaged in convoying our own merchant ships; the capture of the fleets of the enemy; the destruction of his commerce; cutting off his supplies; capture of colonial dependencies; the transportation of large bodies of troops from point to point, and the blockade of his harbors. These are the duties of the navy. But if called upon to man floating batteries, and to defend harbors which may be better protected at less cost by permanent fortifications, or to land in large bodies, and effect permanent lodgments on the enemy's territory, good seamen are at an enormous cost turned into indifferent soldiers. To perform these specific duties, suitable ships in sufficient numbers must be provided. What are suitable ships?

A man of war, to be efficient, must be able to keep the sea for a considerable period, certainly four months; otherwise, her frequent entrance into port for supplies, would give the enemy all the information he desired as to the force, destination, and cruising ground of the fleet or ship. None but the smallest sailing vessels are forced into port oftener than once in four months, while the larger ships may keep the sea six months. Steamers of full power, that is, those capable of making ten knots and upwards under steam alone, are unable to carry more than fifteen days' fuel, which may be made to last with very moderate speed double that period, or thirty days, and without fuel they are comparatively helpless; consequently, when the scene of the intended operations is distant, the sailing ship can reach the rendezvous in as short a time as the steamer. The greatest distance yet passed over under steam was about 4000 miles, at an average rate a little less than eight miles an hour; while the passage of the *Flying Cloud* to San Francisco exceeded the rate of eight miles and a half an hour, and was but three or four days longer than those of the *Golden Gate* and *Winfield Scott*, two crack steamers, which were forced to make three ports by the way. The propeller steamship *S. S. Lewis* reached San Francisco in 124 days, beaten by nine-tenths of the California fleet.

It may be objected to this comparison, that our men of war do not equal the *Flying Cloud* in speed; nor are the steamships in this respect equal to the *Golden Gate*. The speed of our men of war is not, however,

to be judged of by their passages, for we have no object in forcing our ships, and under ordinary circumstances in time of peace, no officer is justified in risking the smallest spar; the object of the cruise is accomplished by the presence of the ship on the station. Nevertheless, the passages of some of our ships have never been equalled by the finest of the clipper fleet.

We are of opinion, therefore, that it is not proven that the steamer possesses any great advantages in making a passage, except under peculiar circumstances of constantly adverse winds and currents, when the distance is greater than the steamer is enabled to make without calling at a port or ports by the way.

Hitherto we have considered the relative capabilities of the two ships for keeping the sea or making a passage, but it must be evident that this is one of the least of the conditions to be fulfilled.

The extent of a navy being governed by the ability of the nation to sustain the cost of construction and maintenance, the steamship ought to be of at least equal military force with her sailing rival of the same cost; else, on her arrival at her destination, she will be forced to accommodate herself entirely to the movements of the enemy. On this point, the relative force of the two ships, the most erroneous notions prevail. One gun mounted upon a steamer is assumed to be equal to the battery of a ship of the line. This notion is, however, but the reproduction of a long since exploded system; that of a navy of gun-boats, for steamships are but gun-boats moved by steam instead of sweeps. "In calms, gun-boats are the sovereigns of ships of the line," says an able writer; and from naval histories he gives terrible examples to prove the truth of his assertion. The system no longer has an advocate, and experience has proved that individual examples to the contrary do not invalidate the general rule that superior force must ultimately triumph.

The great fallacy upon which the enthusiast and the ignorant base their argument in support of this opinion is, that steamers are able to assume at will any position, in spite of the efforts of the sailing ship. They begin with the assumption, that a dead calm prevails, and their adversary floats motionless on a glassy sea, "like a painted ship upon a painted ocean," helpless. This assumption cannot be granted, for an examination of the logs of many ships shows that calms are by no means common; in fact, that, except in the close proximity to land, and in certain latitudes easily avoided when lying in wait for an enemy, it is very uncommon for a ship not to have steerage way. We will, however, admit, that it is during a calm that a well appointed steamer falls in with an equally well prepared frigate. The effective range of the eight and ten inch shell guns, with which steamers are armed, is about 1200 yards, and of course, with her very small number of guns and ability to choose distance, it is her advantage to maintain the distance which makes her gunnery most effective. At this, as well as at any other distance, the eight inch shell guns of the frigate are at least as effective as those of the steamer, while the whole battery of 32's will tell with solid shot; consequently, the steamer must avoid the frigate's broadside; but to pass over a quarter of a circle to get from the broadside to the stern or bow of the sailing ship, she must pass over a distance of 2000 yards, which at eight miles the hour, takes eight minutes. Now, will any seaman believe that

the direction of the ship's head cannot be altered eight points in as many minutes? The two quarter boats, with a line from the end of the jib-boom, will tow her round; or parachute drags may be laid out abeam, (with a similar machine the late Com. Porter propelled the *Essex* three miles an hour;) or an athwartship propeller, as proposed by R. L. Stevens, Esq., and a similar one experimented on in England, worked by hand or a small engine of ten horse power. Other methods will doubtless suggest themselves; so that, in our opinion, this idea of choosing position is altogether delusive. If the steamer closes to a less distance, she comes within range of a broadside of 6½ inch shells, which, though not quite equal to the 8 inch, are yet quite sufficient for the purpose, and the steamer fights at the terrible odds of six guns to fifty.

Should the frigate be fallen in with in a good working breeze, the steamer can only choose distance, (and that only in case of being faster,) but has still less opportunity of selecting position.

Even if we grant the steamer the claimed choice of position, the advantages to be derived from this are not by any means evident; the sterns of ships are no longer made for ornament alone; a frigate can in half a minute shift six guns from her broadside to her stern, which is, in proportion to its developement, as formidable a battery as her broadside; added to which, the steamer being herself in motion at a rapid rate across the line of fire, delivers her shot at a greater disadvantage than the sailing ship, which is either quiet or slowly rotating on her heel. Steamers when not under sail are particularly uneasy in a sea-way, making the pointing their guns very difficult.

But, say the advocates of the steamer, she being armed with larger and heavier guns, will lay off abeam out of danger, and hammer her adversary without caring to choose position. This is another assumption not borne out by the facts. The steam frigates *Saranac* and *San Jacinto** each mount six eight-inch guns; four in broadside, the other two on pivot carriages; the whole may be fought on one side.† The first class frigates mount each fifty guns; eight of which are eight-inch, the remaining forty-two are of 32 lbs. calibre; by shifting over, thirty-two guns may be fought on one side. The two pivot guns are of slightly greater power than any gun on board the frigates *as now armed*, but not to such an extent as to overcome the disparity of six to thirty-two. This disparity in numbers must always exist, for the steamers are already loaded down with their machinery and battery, and any increase of guns requires a corresponding addition of men, ammunition, and provisions. The disparity in the power of the guns may be met by putting corresponding guns on the frigates; this has been done in the case of the small frigate *Raleigh*, which mounts two heavy eight inch guns on pivots, twenty common eight inch shell guns, and two long thirty-two pounders. We must confess that on comparing this ship with the *Saranac* or *San Jacinto*, we cannot believe that any advantages of position likely to be obtained by the steamer can compensate for her decided inferiority of four to one in military force.

The *Mississippi*, carrying no long guns, is, in our opinion, decidedly inferior to the preceding steamships; while the *Susquehanna* and *Powhattan*

* We prefer choosing illustrations, when practicable, from our own service.

† This is, however, at sea, a questionable advantantage; the heel towards the enemy caused by shifting over permits the deck to be *commanded*.

are but larger editions of the *Saranac*, and in force, as in cost, are only to be compared with ships of the line. As to the *Princeton*, her armament of four light eight inch guns, and six light thirty-two pounders, is decidedly inferior to that of any first class sloop in the navy. The first class sloops mount twenty-two guns of greater power, and would bore her through and through before she could effectively return a shot.

The favorite policy of keeping at a distance led to a preference of a few guns, and those of great calibre, more particularly adapted to the firing of shells. There are, however, certain practical difficulties in the handling of heavy guns and their shot, which very much diminish their theoretical superiority over the thirty-two, which is the calibre generally used in the frigates. In mere *range*, the eight and ten inch guns are not equal to the thirty-two, as may be shown by reference to the Ordnance Manual; and being armed with shell guns, to the exclusion of solid shot, except at short ranges, the steamship is within the reach of shot long before her guns would tell. Shells are very far inferior in both range and accuracy to shot, and in view of this, the preference of shell guns does not appear to rest on a sound basis, but is a mere theory; they are as yet untried in actual warfare, and the records of authentic practice show that not more than one-fifth the shells fired at a target placed at a known distance, explode satisfactorily. The frigate, therefore, has at great distances numerous solid shot guns for deliberate fire, and at closer quarters, a broadside of either, or a mixed volley of shot and shell, with a numerical superiority of six to one.

The heavy guns placed on the bows and sterns of steamships, are necessarily mounted on pivot carriages on the spar deck, which makes it necessary to remove the bulwarks, either entirely, as in the *Saranac*, or partially as in other steamers. This exposes the *personnel* at all distances to effects of shell, and particularly the spherical case or shrapnel shell, and at close quarters to grape. The eight inch spherical case, containing about 400 missiles, may be employed at a range of 2500 yards, a distance beyond the effective range of any other species of projectile. The principal battery of the frigate is entirely protected, and the spar deck except from a raking position, in which last case, the exposed guns being inoperative may be temporarily abandoned, and the men sheltered.

We have now to consider the steamer when forming a part of a fleet. Here, forming a part of the line of battle, the integrity of the formation must be preserved; she has no opportunity of selecting her position; her usefulness is dependent on her absolute force, and she may be crushed at once by the superior ship to which she is opposed. If she keeps aloof, or acts the part of a tow boat, her armament is inoperative, and she renders no service to compensate for her cost. But she cannot be depended upon for towing; she may be disabled, or the tow rope may be cut by shot; this last is not a hypothetical case, for the loss of a Danish ship of the line during the late troubles with the Dutchies, was owing to this cause. The tow cannot be under sail; consequently, once adrift while making sail, she is, for a short time at least, an unresisting target. The true position of the steamship is as a reserve for assisting disabled vessels, not a principal actor in the fight.

There is one point in the paragraph we have quoted which we have

not as yet attempted to dispose of. That "steamers can back out of difficulties and dangers, when sailing vessels must remain exposed," we must in the abstract admit; but in order to give them this faculty there is no necessity of depriving them of four-fifths of the military force due to their tonnage. In the side wheel steamship in our service, the engines and fuel occupy nearly, if not quite, half the whole space beneath the water line. In the *Princeton*, if all her fuel was below, not less than three-fifths of her entire capacity would be occupied by machinery, fuel, and stores; so that no economy of space, at least in this instance, is gained by the propeller. The English steam frigate *Arrogant*, which has become quite familiarly known to the readers of this *Journal*, and celebrated for her efficiency, carries but forty guns, when the battery due to her tonnage is sixty; to compensate for this diminished force, she carries but eight days' coal, steaming at sea at a maximum rate of 5·08 knots, (*Vide Jour. Frank. Inst.*, *May*, 1852.) This is probably the maximum rate at which it is necessary that a war steamer should be propelled; it is ample for all the purposes of manœuvring, and for making head against the most rapid currents of the ocean. The boilers and machinery necessary occupying but a limited space, may be placed with, say ten days' coal, far below the water line, and when necessary, fifteen to twenty days' coal may be carried in bags. The risk of accident, which forms so serious an item to their disadvantage, to be allowed for in comparing the efficiency of the present steamers, is reduced to a mere trifle. Further improvements may be expected in the engines and boilers, and models of the ships, (the *Arrogant* is by no means a good model,) and we may succeed in giving a steamship this velocity without displacing so great a portion of her battery as to seriously affect her force.

To the present time, then, we assert that military efficiency has been sacrificed to speed, without attaining the latter, and nothing but a mongrel has been produced, as must always be the case when we aim to combine in one, several contradictory qualities. We require for one purpose, great military force, with sufficient power to render it available when calms, contrary winds, or adverse currents prevent our approaching in sailing vessels the object to be attacked; and for the other, great speed, room for the accommodation of troops, and moderate draft of water.

The first is to be obtained by applying to every ship a small propelling apparatus, the drag of which will not materially affect her sailing qualities when not steaming, but which will be sufficient to manœuvre her in presence of the enemy, enable her to enter ports, or pass through regions of calms to those of favorable winds.

For despatch vessels and troop ships, the mail steamships now in existence under contract with the government, are admirably adapted; they can carry a sufficient battery for the purposes of defence, and their speed insures them impunity where superior force is concerned. It is unnecessary to discuss in this paper, whether it is a wiser policy to continue the subsidies to these steamers and establish new lines of similar vessels, or to build vessels of similar qualities, or to trust to the natural developement of commerce. We have combated what we believe to be false positions and fallacious arguments, and have indicated the wants and requirements

of the Naval Service. The facts are indisputable, the inferences we think legitimate.

Naval officers are, of all others, most interested in this subject, for they feel that much will be expected of them in a future war, and they *know* that the means placed at their disposal are not capable of producing the required effects.

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## *Drainage of Haarlem Meer.**

It appears from a paper by Mr. Grainger, C. E., before the Scottish Society of Arts, that this great work is nearly approaching its completion. The pumping was commenced in May, 1848, from which date to April 30, 1851, the lake had been lowered 7 feet 3 inches, which was the state of matters when the subject was last brought before the Society. During the months of May, June, July, August, September, and October, very satisfactory progress was made, notwithstanding that a considerable quantity of rain fell in August and September, the level reached at the end of October being 9 feet 7·74 inches below the original surface, or at an average rate of 4·79 inches per month. In November a great quantity of rain and snow fell, raising the level about 4 inches; and in December the weather was still unfavorable, so that at the end of the month the level stood at 9 ft. 5·58 in. below the original surface, or a total gain since April 30, of 2 feet 5·58 inches, or 3·32 inches per month. This progress may appear to be inconsiderable; but, when it is recollected that the lowering of the lake one inch involves the raising of upwards of four millions of tons of water, and allowing for the rain and snow falling during these eight months, there could not have been less than 186,000,000 tons of water pumped up during that period, the performance will appear great indeed. To give a better idea of this, it was stated that 186,000,000 tons was equal to a mass of solid rock one mile square and 100 feet high, allowing 15 cubic feet to a ton. The average progress has been less last year than it is in the preceding one; but this is readily accounted for by the *increased lift* of the pumps, and by the difficulty of forming the channels which lead the water to them. At the commencement of these operations, the average depth of the lake was 13 feet 1·44 inches, and as 9 feet 5·58 inches have been pumped out, there only remained at the end of December last an average depth of 3 feet 7·786 inches. It is, therefore, trusted that the drainage will be completed, if not in the autumn of this year, at least in the summer of 1853.

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## *Ordnance Range and Velocity.*†

The longest range and greatest velocity ever accomplished by any ordnance, ancient or modern, up to the period of 1840, and we believe to the present time, is 5720 yards, or just three miles and a quarter. The whole time of flight was only thirty seconds and a quarter, which is estimated at 2100 feet in the first second of time. The piece of ordnance

* From the London Mechanics' Magazine, July, 1852.

† From the London Practical Mechanic's Journal, July, 1852.

used on this occasion was a fifty-six pounder cannon, cast on the principles of Mr. Monk, who suggested the propriety of removing a considerable proportion of useless metal from the gun before the trunnions, and adding it to the breech, where alone increased strength is desirable. This arrangement permits the use of a larger projecting charge of gunpowder, without risking the calamity of bursting. The quantity of powder employed in the experiment alluded to was ten pounds, and *the ball weighed sixty-two pounds and a half*, a circumstance which requires some explanation, seeing that we have stated the gun to be a fifty-six pounder. The explanation is this: the momentum of a projectile is the product of its mass and its velocity; by increasing that mass, therefore, or, in other words, by adding to its weight without adding to its size, we acquire a proportionate increase of momentum, and a consequent increase of range. The shot on the present occasion was an iron shell filled with lead; hence its weight of sixty-two pounds and a half. Nearly the same range was accomplished by the French during the Peninsular war, who threw shells into Cadiz, rather more than a distance of three miles; they, however, used enormous mortars, one of which is at present in St. James's Park, and employed the largest charges of gunpowder ever known in modern times; the missiles projected, moreover, were shells *nearly* filled with lead, the remaining space containing gunpowder, ignitable by a fuse, as in the common shell. The fact that leaden balls accomplish a longer range than iron ones, seems to have been discovered at least *once* by chance, the discoverers being totally ignorant of the principles on which the circumstance was founded. It is related that, during the war, an American ship having expended all her cannon-balls, and being unable to procure others of a similar kind, had some prepared of lead; when, on employing them in a subsequent action, her captain and crew were surprised at their long range and efficacy. Sir Howard Douglas is so satisfied of their advantages on peculiar occasions, that he recommends their introduction in the navy.

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## *Death of Sir James Macadam.**

Sir James Macadam, the originator of the modern system of "macadamizing" roads, died on Wednesday in week before last, at his residence in Finchleysroad, London.

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## *Enclosure of Land from the Sea in the Netherlands.†*

The first sod of the lands conceded to the Netherlands Land Enclosure Company by the Government of Holland was turned by Captain Pelly, on Thursday in week before last, at Hanswerk, Zealand, Holland, in the presence of a large concourse of the population. In the Scheldt, between Bergen-op-Zoom and Antwerp, there exist large tracts of land covered at high water by the sea, and at low water presenting a varying surface of several feet in depth of the richest alluvial soil, ever on the increase. To redeem and dispose of this land is the object of the company named, which is composed of practical men on both sides of the Channel, with Sir

* From the London Builder, No. 494, July 24, 1852.

† From the London Builder, No. 492.

John Rennie as engineer-in-chief. The necessary powers have been granted for ninety-nine years from last August, under which the company may recover and enclose land to the extent of 35,000 acres. The reclamation will cost 20*l.* per acre they say, and the land reclaimed will be worth from 60*l.* to 70*l.* per acre.

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## AMERICAN PATENTS.

*List of American Patents which issued from Sept. 14th to Oct. 5th*, 1852, *(inclusive,) with Exemplifications by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

17. For an *Improvement in Clothes Pins;* Samuel Aldritch, Springfield, Vermont, September 14.

*Claim.*—"I do not claim the invention of pins for securing clothes to the line; neither the invention of the coiled spring or lever; neither the combination of the parts of the same. But I do claim the improvement of manufacturing clothes pins from wire of any suitable metal, with the aforesaid jaws attached, operated by a spring or lever, as being the most simple, cheap, effective, and durable, of any kind in use."

18. For an *Improvement in Connecting Joints for Washing Machines or other purposes;* S. L. Egbert and S. W. Green, Willoughby, Ohio, September 14.

*Claim.*—"What we claim as our invention is, the construction of the joint, (by which the connecting rod is attached to the spring board,) by means of the knife edges disposed in a right line, and confined by the straps and backing piece, substantially as herein set forth."

19. For *Improvements in Printing Presses;* Charles W. Hawks, Boston, Massachusetts, September 14.

*Claim.*—"Having fully described the construction and operation of my improvements, I will now point out the parts which I claim as my invention.

"1st, I claim a pair of nippers, so constructed as to draw the paper from the form, by griping the margin of the paper firmly between the jaws of the said nippers, and at the same time holding the paper a little distance from the platen, as herein described and set forth.

"2d, I claim the adjustable spring and rod, for holding the nippers up from the platen, as herein described.

"3d, I claim the fingers for holding the edge of the sheet, in combination with the swing platen, as herein set forth."

20. For an *Improvement in Lightning Rods;* Herman H. Homan, Cincinnati, Ohio, September 14.

"The object of my invention is the production of a self-renewing lightning rod point, of the greatest possible efficiency of operation and simplicity of construction."

*Claim.*—"Having thus fully described the nature of my improvements in lightning rod points, what I claim therein as new is, 1st, The formation of the point of a lightning rod of successive sections of different metals, each being of greater fusibility than the one below it, and having oblique junctions, so that an overcharge of the electric fluid simply melts off the upper section, without enlargement of the point below, either by its own partial fusion or by the lodgment of the upper metal upon it.

"2d, Uniting the successive sections of an obliquely sectional lightning rod point, by solder or brazing, which is at each joint fusible at a lower temperature than the section immediately above it, so that the melting of the point shall remove the entire uppermost section, and thus more certainly prevent the lodgment of any portion of the melted section upon the point thus exposed."

21. For an *Improvement in Smut Machines;* Charles and James Keeler, Union, New York, September 14.

"The nature of my invention consists in constructing the wind passages and spouts in

such a manner as to allow of their being turned to either side, to allow the machine to be driven in either direction."

*Claim.*—"What we claim as our invention is, making the blowing apparatus, with the drawer and spout, movable, substantially as described, so as to allow of the wind-chest and pipe being easily taken out, and turned in either direction, to admit of the machine being driven in whichever direction may be desired."

22. For *Machinery employed in the Manufacture of Coiled Wire Ferrules;* William T. Richards, New Haven, Connecticut, September 14.

*Claim.*—"I am aware that clamps or holders and cutting dies have been worked by cranks and cams; I therefore do not claim these, as such, as my invention. But what I claim as my invention is, the method of cutting the wire at right angles to the axis of the coil, so that the ends of the ferrules will be perfectly true, without wasting any of the stock, by the use of the short mandrel, the clamp or holder, and the cutting die, when the machine is constructed, arranged, and made to operate substantially as herein described.

"I also claim the combination of the method of cutting the coil (as described above) with the method of supporting the long coil, and of feeding it, and of throwing off the piece when severed, when combined, arranged, and operated substantially as herein described."

23. For an *Improvement in Shuttle Guides to Looms;* Horace T. Robbins, Lowell, Massachusetts, September 14.

*Claim.*—"I claim as my invention, 1st, The guide or its equivalent, either with or without the flanch, in combination with cloth-weaving looms, or as applied and used therewith, substantially in the manner and for the purpose of guiding the shuttle as specified.

"2d, I claim the spring and finger, or their equivalent, so arranged as to hold the guide in its proper place, substantially as specified."

24. For an *Improved Machine for Manufacturing Porte Monnaies;* Benjamin S. Stedman, West Meriden, Connecticut, September 14.

"This invention relates to certain means of inserting the leather or other material of which the sides of the porte monnaies and other similar cases are made, in their metal frames, by which a great saving in manual labor is effected, and the work performed in a better manner than by the common method."

*Claim.*—"What I claim as my invention is, 1st, The manner, substantially as described, of putting the leather or other material in the frames, by forcing a sufficient quantity through the frame, with a die or plunger, at the back side, and then by a larger die pressing the part so forced through, and folding it over the inner edge of the frames.

"2d, The form and construction of the clamp, which holds the frame and the leather or material, to wit: the lower part having an opening just large enough to allow the die on the back side to pass through, and the upper part having an opening large enough to allow the larger die to pass through, and fold the leather or material over the frame, and having a recess in its inner or bottom face, around the said opening, to receive and hold the frame in it, so that the leather or material is held independently of the frame, and allowed to be drawn through the frame, substantially as herein described."

25. For an *Improvement in Door Locks;* William Moore, Williamsburg, New York, Assignor to James Carman, City of New York, September 14.

*Claim.*—"The dividing plate being well known, is public property; therefore, forms no part of my claim: neither do I claim any of the parts operated from the outside key-hole, as these may be of any usual form. But what I claim is, the tumbler, enclosed by the dividing plate, to be operated on solely by the key, when entered from the inner key-hole, in combination with the revolving check, or its equivalent, and the bolt, for the purpose and as described and shown."

26. For *Improvements in Forging Machines;* George H. Richards, West Roxbury, Assignor to Calvin G. Plimpton, Walpole, Massachusetts, September 14.

*Claim.*—"I claim the sliding guide traversing upon the side bars, as described, having a pin, pivot, or fulcrum, one end of which is attached to the sliding guide, while the other end of the hammer, in which it is so fitted as to allow the hammer to turn a short distance, when power is applied to it by means of the crank, cam, or eccentric and the connecting rods."

27. For an *Improved Alarm Time Piece for Lighting Lamps;* William H. Andrews, Cheshire, and Randal T. Andrews, Plymouth, Connecticut, September 21.

"Our improvement consists in using a longitudinal section of a hollow cylinder, placed vertically in the lower part of the case of the time piece, with the lamp, match, &c., placed in it, so as to be within the case when not in use, but so that when the alarm is let off, the cylinder will be revolved one-half of a circle, the lamp lighted, and presented in front of the case of the time piece, for the convenience of the user."

*Claim.*—"What we claim as our invention is, the use of a revolving vertical section of a cylinder, when combined with a spring to revolve it, when these are combined with the appropriate levers, and connected with the alarm wheel of an alarm time piece by an appropriate connecting rod, for the purpose of lighting a lamp, in connexion with the alarm given by an alarm time piece, when the whole is constructed, combined, and arranged substantially as herein described."

28. For an *Improvement in Tuning Pegs for Guitars, &c.;* James Ashborn, Wolcottville, Connecticut, September 21.

*Claim.*—"What I claim as my invention is, making the tuning pegs of guitars and other like stringed instruments, with the journal part of much greater diameter than the barrel on which the string is coiled, substantially as and for the purpose specified."

29. For an *Improvement in Carving Machines;* Charles E. Bacon, Buffalo, New York, September 21.

"The nature of my improvement consists in giving to a vertical or inclined cutter, a motion laterally in any direction, at the same time it has a rapid rotary motion, for the purpose of producing a fac simile of any pattern or device, or for carving or cutting from patterns or originals previously made, or for cutting a pattern or device which shall be the reverse of the original, that is, having projections where there are cavities in the original, and vice versa."

*Claim.*—"What I claim as my invention is, the folding frame and wheels or pullies, constructed substantially as above described, in combination with the double cross sliding ways and vertically sliding cylinder or tracer, for the purpose of tracing from patterns or other device, in the manner above specified."

30. For an *Improvement in Coating Iron with Copper;* Theodore G. Bucklin, Buffalo, New York, September 21.

*Claim.*—"Having thus described my invention, I do not claim the preparation of iron with zinc, in the manner described; but I claim, 1st, Coating cast, malleable, or wrought iron, with copper, or any of the alloys of which copper forms a part, by employing a coating of zinc, or zinc and tin, to cover the iron, as a positive medium to make the molten copper or its alloy adhere to the iron, in the manner substantially as described.

"2d, I claim the employment of an infusible or partially infusible substance or substances, especially the fluoride of calcium, as a wiper and non-conductor, as herein set forth."

31. For an *Improved Hand Drilling Machine;* Reuben Daniels, Woodstock, Vermont, September 21.

*Claim.*—"What I claim as my invention is, the combination of the geared mandrel, which elongates, to feed the drill, with the arm that projects from the sleeve, to steady the gearing, and the slot in the stock, to guide and steady the arm, while traversing therein, to permit the drill to be advanced and withdrawn, as herein set forth."

32. For an *Improvement in Horse Collars;* J. H. Hall and John Lowrey, Wheeling, Virginia, September 21.

"Our invention consists of a metallic framed collar, which can be expanded or contracted to suit horses of different size, and which maintains the parallelism of its sides, however much it is expanded or contracted."

*Claim.*—"We do not claim a rigid collar, nor a collar capable of expansion and contraction sidewise, when the sides are connected by a third or intermediate part, or supported by a frame; but what we do claim as our invention is, the construction and arrangement of the two sides of the collar, so that they fit together, and can be moved towards and from each other by a parallel motion, to diminish or enlarge the aperture for the horse's neck, and then be fastened by a set screw, or its equivalent, to form a rigid frame, substantially as herein described."

33. For an *Improvement in Portable Wardrobes;* Seth L. Hobart, Hingham, Massachusetts, September 21.

*Claim.*—"Having thus described my improved wardrobe, what I claim as my invention is, a wardrobe susceptible of dismemberment, with the parts held together by means of the sliding bolts, which fit into sockets, and the notched studs, which fit into the grooves, the top piece preventing the back from slipping by the bolts, and the sides being prevented from slipping by the projecting pieces, which press the braces forward, and keep the studs pressed forward as above described."

34. For an *Improvement in Machinery for Beveling the Edges of Skelps or Metallic Strips &c.;* Robert Knight, Cleveland, Ohio, September 21.

"The nature of my invention consists in the arrangement of rollers in a frame work, so to receive a lateral movement or end play, one over the other, for the purpose of increasing or diminishing the distance between bosses on the rollers, according to the width of the strip or plate of which the flues and pipes are made."

*Claim.*—"What I claim as my improvement is, arranging the rollers in the frame, so as to receive a lateral movement as may be desired; in other words, giving the rollers end play, one over the other, as thereby increasing or diminishing the distance between the bosses, (according to the width of the plate or strip,) and providing suitable means for retaining the same in place."

35. For an *Improvement in Rakes;* Amza B. Lewis, Brooklyn, Wisconsin, September 21.

*Claim.*—"What I claim as my invention is, the combination of the slotted, swinging arm with the slotted rake handle and crank, in manner as above described, for moving the cut grain from the platform."

36. For an *Improvement in Paper Cutting Machines;* James E. Mallory, City of New York, September 21.

*Claim.*—"Having fully described the nature of my invention, what I claim as new therein is, the arrangement of the movable platform and sliding clamp, as described, in combination with the vibrating knife, as described."

37. For an *Improvement in Crayon Rubber;* Daniel F. Pond, New Haven, Connecticut, September 24.

*Claim.*—"I do not claim as new, the casting of particular forms of vulcanized rubber in moulds; but what I do claim as my invention is, the crayon rubber, made in the manner herein before substantially set forth, for the purpose of applying and blending the crayons in the bi-chromatic and other kindred styles of drawing."

38. For *Application of a Free Joint Tube in circumstances where it is exposed to external pressure;* Richard Prosser, Birmingham, England, Assignor to Thos. Prosser, City of New York, September 21; ante-dated May 31, 1852.

*Claim.*—"What I claim as my invention is, the application of the improved metal tube, made in the manner and for the purposes as herein before described, that is to say, of a metal tube with a free joint, (neither welded nor brazed,) to boilers of steam engines or other vessels requiring metal tubes, of such a character as to resist external pressure effectually."

39. For an *Improvement in Galvanic Clocks;* Moses G. Farmer, Salem, Massachusetts, Assignor to himself and Charles C. Coffin, Boscowen, New Hampshire, September 21.

*Claim.*—"What I claim as my improvement or invention is, the combination of the impulse spring and the pallets, respectively connected with the armatnre of the magnet and the pendulum, and made to operate together, and to make the pendulum operate or impart impulse to it, substantially as described."

40. For an *Improvement in Shoes and Gaiter Boots;* Joseph Brackett, Swampscott, Massachusetts, September 28.

*Claim.*—"What I claim as my invention is, the improved gaiter boot or shoe, as made with a lap piece separate from both the quarters, and extended up from the instep part of it, in combination with so applying button holes and buttons, or their equivalents, to the said lap piece and the two quarters, as to enable the two quarters to be directly connected by the lap piece, all substantially as above specified."

41. For an *Improved Jointed Bed Plate Saw Gummer;* Hosea O. Elmer, Mexico, New York, September 28.

"The nature of my invention consists in the combination of a cylindrical cutter, having a rotary motion, and placed on a frame having a reciprocating and rectilinear motion, with a jointed bed, within which the saw to be filed and gummed is clamped, by which combination both the under and inclined faces of the teeth are filed perfectly true, and the saw gummed and jointed."

*Claim.*—"I do not confine myself to any particular mode of doing this, viz: supporting the bed piece; nor do I confine myself to the particular mode of construction of the several parts as herein described, but any other method substantially the same, so long as the bed piece is jointed, and one part capable of being clamped, when in line, or at an angle with the other part; I do not claim the cylindrical cutter separately, as that has been previously used. But having thus described the nature of my invention and the manner in which it is operated, what I claim as new is, the employment or use of the cylindrical cutter, the said cutter having a rotary and also a reciprocating rectilinear motion, in combination with the jointed bed piece, in which the saw is placed, the cutter having the above motions communicated to it in the manner as described, or in any equivalent way, and the bed piece being constructed substantially as shown and described; by which combination, saws may be filed, gummed, and jointed, in an expeditious and proper manner, as set forth."

42. For an *Improvement in Piano Forte Action;* George Howe, Boston, Massachusetts, September 28.

*Claim.*—"Having described my improvement in piano forte action, what I claim as my invention is, jointing the fly of the jack to the stem of the same, so as to constitute a lever, the short arm of which has to move but little distance before it strikes against the regulating button, for the purpose of preventing any noise or "slapping," as above set forth."

43. For an *Improvement in Throstle Spinning Machines;* Charles H. Hunt, Lawrence, Massachusetts, September 28.

*Claim.*—"What I claim as my invention is, the escapement wheel, O, its escapement lever, (composed of the arm, *h*, and pallets, *i k*,) and stud, *y*, in combination with the reciprocating rotary mechanism, composed of the wheel, P, its concentric and endless grooves, row of pins, the pinion, *p*, and pendulous bar or arm, *r*; the whole being applied to give motion to the shaft, N, its pinion, the gear of the shaft, K, and the said shaft, K, in order to effect the movements of the spindle rail or rails, essentially as above specified."

44. For an *Improvement in Saw Mills;* Hazard Knowles, City of New York, September 28.

*Claim.*—"Having fully described my improvements in saw mills, what I claim therein as new is, the adjustable ways of the saw gate, when they are connected with each other in such manner, that they can be simultaneously and uniformly raised and adjusted in their positions, whilst the saw gate is in motion, for the purpose of varying the amount of the cutting action of the saw, substantially as herein set forth.

"I also claim the connecting and arranging of the feeding apparatus with the saw gate, and the adjustable ways thereof, in such a manner, that the feeding motion communicated to the material operated upon, will invariably be in perfect harmony with the cut of the saw, and also in such a manner as will enable me to ease the action of the saw, when passing through knots, and at any time adapt it to the nature and the depth of the material operated upon, substantially as herein set forth."

45. For an *Improvement in Brick Kilns;* Richard E. Schroeder, Rochester, New York, September 28.

*Claim.*—"Having fully described the construction and operation of my improved kiln, in the several processes of burning brick, I would state that I do not claim constructing a stationary kiln of masonry; but what I do claim as my invention is, so arranging the several compartments of the kiln, each provided with a fire place, in a circuit, and connecting them with each other and with the fire places and chimnies, by means of flues and dampers, that one compartment after another may be charged with fresh brick, and the brick be successively dried and heated by the waste heat, burned, cooled down, and removed, substantially as in the manner herein fully set forth."

46. For an *Improvement in Lath Machines;* Henry C. Smith, Cleveland, Ohio, September 28.

"The nature of my invention consists in turning the log or bolt from which the laths are to be cut, by means of poppet heads or wheels, arranged and operated at each end of said log or bolt, and driven by the same first moving power, or so as to have the same relative velocities, by which means all wrenching or twisting of the log upon its centre is entirely obviated, and it is firmly held up to the knives to be operated on it; and also in combining therewith the detachable dogs and hollow mandrel, for the purpose of clutching or releasing the log or bolt, and for centreing said bolt before it is placed upon the mandrels."

*Claim.*—"Having thus fully described the nature of my invention, what I claim therein as new is, the combination of the method of rotating the log or bolt from which the laths are to be cut, by means of the poppet wheels, arranged respectively on the shafts, and forms a part of the mandrel at each end of the log, and the gear wheels, or their equivalents, moving with equal velocities, so as to prevent any wrenching or twisting of the log on its centres, and to hold it firmly up to the knives whilst being operated upon by them, and the method of clutching and releasing the log, by means of the dog, hollow bearing for containing the clutch head, and hollow shaft for receiving the rod, which screws into said clutch, and by which the dog may be driven into the log, or the log released; the whole being arranged and operating substantially in the manner and for the purpose set forth."

47. For an *Improvement in Sounding Boards of Piano Fortes, &c.;* Alfred Speer and Ernest Marx, Aquackanock, New Jersey, September 28.

*Claim.*—"What we claim as our invention is, making the sounding board of a piano forte, or other stringed musical instrument, and arranging the strings and all appendages thereto, in the form of a cylinder, or part of a cylinder, or in any of the forms we have mentioned, as considered to be equivalent; the said board having its ends secured between two disks or heads, and having no other support, except that derived from the said disks or heads."

48. For *Improved Machinery for Forming Sheet Metal Tubes;* Orson W. Stow, Southington, Connecticut, September 28.

*Claim.*—"I do not claim the manner of forming tubes by means of a rod and concave bed, irrespective of the manner of operating the rod, for they have been previously employed, the rod being operated or driven in the bed, by means of a mallet or hammer, operated by hand, or by means of levers or cranks moved by gearing. What I claim, therefore, as my invention is, 1st, The method of mounting and operating the rod within the concave bed, in the manner as shown and described, viz: the ends of the rod being attached to the slide rods, and slide rods passing through the vertical guides, and having spiral springs around them, the lower ends of the slide rods being attached to levers, by operating which the rod is forced within the concave bed, and the lower portion of the tube formed.

"2d, I claim the hinged folders attached to the wings, which are hung on points, said points being in line longitudinally with the centre of the rod, and operated in the manner and for the purpose of forming the upper or remaining portion of the tube, as herein set forth."

49. For an *Improvement in Registers for Omnibuses and for other purposes;* J. Z. A. Wagner, Philadelphia, Pennsylvania, September 28.

*Claim.*—"What I claim as my invention is, fitting toll passages with a registering step, combined with mechanism, in such manner, that the aggregate number of full and fractional tolls due from passengers will be reduced to the denomination of full tolls, and registered, whatever the proportions may be in which the aggregate is composed of fractional and full tolls, substantially as herein set forth."

50. For an *Improvement in Bellows for Reed Instruments;* Isaac T. Packard, Campello, Massachusetts, September 28.

*Claim.*—"What I claim as my invention is, the employment in all reed instruments of bellows, having two chambers, in one of which a vacuum is produced, and in the other air is compressed, the said chamber being on opposite sides of the reeds, and communicating with each other, through the reeds, so that when one forces air through them, the other, by the vacuum, draws it through at the same time; this I claim without reference to the precise construction of the bellows, or the mode of operating them."

51. For an *Improvement in Electro-Magnetic Engines;* John S. Gustin, Trenton, New Jersey, September 28.

"The nature of my invention consists in the arrangement of a pump and electro-magnets attached to a lever or working beam, with the several parts so adjusted with spring and pendulum, that by the application of a galvanic battery the pump is put in motion, and continues its work steady, without requiring the aid of personal attention, except that which is necessary to replenish the acids in the battery when exhausted."

*Claim.*—"What I claim as my invention is, the application of a spring or springs, or their mechanical equivalent, used as recipients of the excess of power in the closing of the electro-magnets and armature, to be imparted again to the next, as described and set forth."

52. For an *Improvement in Machines for Polishing Leather;* John M. Poole, Assignor to J. Pusey and James Scott, Wilmington, Delaware, September 28.

*Claim.*—"What I claim as my invention is, 1st, connecting or fastening the stand or stands that hold the polishers or burnishers to a belt, so as to traverse them in ways or grooves, or under a plane, substantially as described."

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## Designs for September, 1852.

1. For a *Design for a Medallion of General Scott;* Peter Stephenson, Boston, Massachusetts, September 7.

*Claim.*—"What I claim is, the design of a medallion of Winfield Scott, as represented in the drawings above referred to."

2. For a *Design for a Medallion of Franklin Pierce;* Peter Stephenson, Boston, Massachusetts, September 7.

*Claim.*—"What I claim is, the design of a medallion of Franklin Pierce, as represented in the drawings above referred to."

3. For a *Design for a Coal Stove;* William L. Sanderson, Troy, Assignor to R. Finch, Sr., and Reuben R. Finch, Jr., Peekskill, New York, September 7.

*Claim.*—"What I claim as my invention is, the within described design, configuration, and general arrangement of the forms, ornaments, and mouldings upon the stove as a whole, and upon the following parts individually: the side, back, and front plates; doors; bottom plate; top plate and cover; feet; water vase; cover and front of ash pit; the whole being shown in the accompanying drawings."

4. For a *Design for a Cooking Stove;* Samuel D. Vose, Albany, New York, September 14; ante-dated March 14, 1852.

*Claim.*—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the general combination of the several mouldings and ornaments, as arranged together, the whole forming an ornamental cooking stove, as herein set forth and described."

5. For a *Design for a Parlor Stove;* Conrad Harris and Paul W. Zoiner, Cincinnati, Ohio, September 14.

*Claim.*—"What we claim as our invention is, the combination of the scrolls and foliage, arranged as set forth in the annexed drawing, so as to form an ornamental design for parlor stoves; to be known and called the Cottage Franklin."

6. For a *Design for a Cook Stove;* Samuel D. Vose, Albany, New York, September 14.

*Claim.*—"I do not claim any detailed part of the mouldings or configuration. What I claim as my invention is, the general combination of the several mouldings and ornaments, as arranged together, the whole forming an ornamental air-tight cook stove, as herein set forth and described."

7. For a *Design for a Cook Stove;* N. S. Vedder, Troy, New York, September 14.

*Claim.*—"What I claim as new is, the ornamental design and configuration of cook stove, the same as herein described and represented in the annexed drawing."

8. For a *Design for a Parlor Stove;* James J. Dulley, Assignor to Johnson, Cox, and Fuller, Troy, New York, September 14.

*Claim.*—"What I claim as new is, the ornamental design and configuration of stove plates, the same as herein described and represented in the annexed drawings."

9. For a *Design for a Camera Stand;* W. A. Allen, City of New York, September 21.

*Claim.*—"What I claim is, the design and configuration of the several ornaments, forming in combination an ornamental stand for cameras and other purposes, as described and set forth."

10. For a *Design for a Wire Fence;* Francis Kilburn, Lancaster, Pennsylvania, September 21.

*Claim.*—"What I claim as my invention is, the design of a wire fence, ornamented as herein described and shown in the accompanying drawings."

11. For a *Design for a Cooking Stove;* Orin W. Andrews, Providence, Rhode Island, Assignor to Isaac Backus, Canterbury, and John Pitt Barstow, Norwich, Connecticut, September 21.

*Claim.*—"What I claim is, the design and configuration as herein shown of the stove as a whole, and of the front, back, and side plates severally."

## OCTOBER.

1. For an *Improvement in Grain Separaters;* Jacob Bergey, Wadsworth, Ohio, October 5.

"The nature of my invention and improvement consists in the manner of sustaining the inclined revolving perforated cylinder, by anti-friction wheels, upon whose peripheries the cylinder turns, it being prevented from descending below its required level by circular or ring projections, or flanches, secured to the exterior of the cylinder, and turning against the sides of the wheels, which themselves turn on short studs or axles inserted into the frame of the machine."

*Claim.*—"Now, I am aware that revolving screens, separately considered, are not new; also, that the conveyer, or endless apron, has been employed, in combination with a threshing cylinder, vibrating shoe and fan, and therefore, of themselves, I do not claim: but what I do claim as new is, the use of a hollow revolving cylinder, so constructed and so moved, as herein fully set forth, for the purpose of a straw carrier, by which the advantages above enumerated and explained are obtained."

2. For an *Improved Vice;* William Butler, Little Falls, New York, October 5.

*Claim.*—"What I claim as my invention is, the arrangement of the sliding bar with the screw attached thereto, with reference to the fast jaw, *a*, and the moving jaw, *b*, when said sliding bar is provided with a series of holes, or their equivalents, and said jaw, *b*, is provided with a pin, or its equivalents, whereby *b* can be set at varying distances with respect to *a*, and that distance afterwards regulated by the screw."

3. For an *Improvement in Hand Printing Presses;* Charles Foster, Cincinnati, Ohio, October 5.

*Claim.*—"Having described my improvements in printing presses, what I claim as new are, 1st, The arrangement, substantially as described, in a hand power press, of guide bars resting upon adjusting points, or hinged at their rear ends, and guided at their front ends to a vertical vibration, concentric with said points or hinges, so that the entire bed, guide bars and their appendages, shall move bodily upward upon giving the impression, and return by their own weight to the state of rest, whether operated by a shaft extending below the bed, and working a toggle joint beneath the bed or bars, as described, or in any equivalent way.

"2d, I claim, in connexion with the before described arrangement, the ascending grade at the fore end of the guide bars, for the purpose of limiting the range of the toggle at the period of giving the impression."

4. For an *Improvement in Seed Planters;* D. Haldeman, Morgantown, Virginia, October 5.

"The nature of my invention consists, 1st, in having the wheel or roller encompassed by one or more tyres, which may be adjusted to the wheel or roller at pleasure, thus increasing or diminishing the diameter of the wheel, and allowing the seed to be planted the required distance apart, as will be hereafter shown."

*Claim.*—"Having thus described the nature and operation of my invention, what I claim as new is, the employment or use of the adjustable tyre or tyres, for the purpose of varying the diameter of the wheel, to allow the seed to be deposited the required distance apart."

5. For an *Improvement in Rotary Stove Grates;* Alexander Harrison, Philadelphia, Pennsylvania, October 5.

*Claim.*—"What I claim as my invention is, 1st, The combination of the rotary move ment of the bottom grate with the vertical annular grating, or its equivalent, surrounding the same, for the purposes substantially as herein set forth.

"2d, I claim the rotary movement of the bottom grate with the controlling tilting movement of the same, substantially as herein described.

"3d, I claim the combination and arrangement of the several parts, whereby the aforesaid rotary and tilting movements of the bottom grate are effected, substantially as herein described."

6. For an *Improvement in Seed Planters;* Robert M. Jackson, Penningtonville, Pennsylvania, October 5.

"The nature of my invention consists in applying a sieve to the machine, which will deposit the fine earth upon the grain, and throw the coarser parts to each side, and a marking rod, by which corn may be planted, to be in rows across as well as lengthwise."

*Claim.*—"What I claim as my invention is, the corn planter sieve and its appendages, for the purpose of sifting and depositing the fine earth upon the grain, and throwing off stones and such matter as would obstruct the young sprout in coming through the ground, substantially as described and illustrated herein."

7. For an *Improved Spark Arrester;* Volney P. and B. Kimball, Watertown, New York, October 5.

*Claim.*—"Having described the nature of our invention and the manner in which it is operated, what we claim as new is, the revolving screen, in combination with the chamber, the lower part of said chamber communicating with the smoke pipe at a point below the tops of the exhaust tubes, by which arrangement a downward draft is created within the chamber, and the cinders drawn from the screen as it revolves, thus preventing the clogging of the screen, as set forth."

8. For an *Improvement in Bee Hives;* Lorenzo L. Langstroth, Philadelphia, Pennsylvania, October 5.

*Claim.*—"What I claim as my invention is, 1st, The use of a shallow chamber, substantially as described, in combination with a perforated cover, for enlarging or diminishing at will the size and number of the spare honey receptacles.

"2d, The use of the movable frames, or their equivalents, substantially as described; also, their use in combination with the shallow chamber, with or without my arrangement for spare honey receptacles.

"3d, A divider, substantially as described, in combination with a movable cover, allowing the divider to be inserted from above between the ranges of the comb.

"4th, The use of the double glass sides in a single frame, substantially as and for the purposes set forth.

"5th, The construction of the trap for excluding moths and catching worms, so arranged as to increase or diminish, at will, the size of the entrance for bees, substantially in the manner and for the purposes set forth."

9. For an *Improvement in Upright Piano Fortes;* R. E. Letton, Quincy, Illinois, October 5.

*Claim.*—"What I claim as my invention is, 1st, extending the upper part of the metallic plate or cap, at the part where the shorter of the strings are placed over the sounding board, and supporting it by blocks or supports, which pass through the sounding board to the frame timbers, substantially as set forth, whereby the higher end of the bridge, or that part on which the strings of the higher notes rest, is allowed to be brought nearer to the centre of the sounding board, to get a better vibration.

"2d, The combination, in the manner substantially as described, of the cushioned block and the adjustable button on the upright wire attached to the key, for the purpose of preventing the entire descent of the hammer, after striking, until the key is left free."

10. For an *Improvement in Machines for Wringing Clothes;* Joseph P. Martin, Philadelphia, Pennsylvania, October 5.

*Claim.*—"Having fully described my invention, what I claim as new is, keeping the ends of the clothes sack distended, during the progress of wringing, to equalize the twisting of the same at all parts, by means of the elliptical spring leaves and elastic wings, substantially as described."

11. For an *Improved Apparatus for Puddling Iron, &c.;* James M'Carty, Reading, Pennsylvania, October 5.

*Claim.*—"Having described my automatic puddling apparatus, what I claim as new is, 1st, the combination of an automatic rable, with a revolving or moving basin, arranged and operated substantially as herein set forth, or with a stationary basin, or bottom, whereby much manual labor is dispensed with, for stirring the iron in the process of puddling.

"2d, The arrangement of the hollow shaft, cooler, and moving basin, in such manner that a stream of water can be kept circulating round the bottom and sides of the latter, to prevent it from being overheated, substantially as herein described.

"3d, The combination of the crank and swinging guides, or their equivalents, which enables the operator to make the rable stir over different parts of the bottom, and at different angles to the side of the furnace, and also to remove it out of the way when necessary."

12. For an *Improvement in Piano Fortes;* James and John McDonald, City of New York, October 5.

*Claim.*—"What we claim as our invention is, 1st, the combination of the wind chest and flute, or other similar wind pipes, with the horizontal piano forte action, in the manner substantially as set forth, to wit: the pipes being placed horizontally at the bottom of the case below the piano forte action, and the wind chest placed below the front ends of the piano forte keys, in such a manner as to allow the valves to be operated directly by the said keys.

"2d, The manner of opening the valves of the flute, or wind pipes, to play an octave lower than the piano, either at the same that they are being played at the same pitch as the piano, or not, by means of the series of levers arranged and operated upon by the blocks upon the vertical pins, under the piano key."

13. For an *Improvement in Printing Presses;* John G. Nicolay, Pittsfield, Illinois, October 5.

*Claim.*—"Having fully described my rotary cone printing press, what I claim as new is, not the use of conical impressing cylinders, but the peculiar arrangement and combination of conical impressing cylinders, one or more in number, each provided with a set of conical distributing inking rollers adapted thereto, and with a rotary wheel or disk, substantially as described.

"I also claim, in combination with the conical impressing cylinders, the position and arrangement of the clamp consisting of the metal plate, spring, and arm or lever, which retains the paper at the required angle to receive the impression, and release the same when the impression is taken, substantially as set forth."

14. For an *Improvement in Expanding Window Sashes;* Mighill Nutting, Portland, Maine, October 5; ante-dated June 16, 1852.

*Claim.*—"I am aware that window sashes, wide enough to fill the window frames for which they were designed, and which, therefore, could not be put in or taken out, without removing the stop strips, have had grooves made in their edges, to receive spring packing to make their joints tight.

"I am also aware that grooves have been made in window frames, and fitted with spring packing, to press against the edges of the sash, to make the joints tight.

"I am also aware that expanding window frames have been made, and the sashes fitted to them, in such manner, that the ordinary stop strip is not required, and that these frames expand to allow the sash to be taken out, and contract to hold the sash in place after it is reinstated.

"I am also aware that this mode of allowing the sash to be put in and taken out is objectionable, because of its cost and its inapplicability to windows of the common construction now in houses, which could not be modified so as to embrace it, without great inconvenience, damage to the plaster of the walls, &c.

"To none of the foregoing contrivances do I lay any claim; neither would I patent or use them, if I were the first who invented them, because of the superior simplicity, cheapness, and utility of the window described, in which I claim as my invention the sash, constructed in two pieces, so that both, when brought together, shall be narrower than the distance between the bottoms of the grooves in the jambs of the frame in which the sash is designed to be placed, by at least the thickness of one of the stop strips of the frame, and connecting these two pieces of the sash in such manner that one will slide past or into the other, so that the sash can be contracted or expanded, as may be required, to make it fit different window frames, and to adapt itself to the varying width of the same

frame, and also to admit of its being put into and taken out of the frame, without removing the stop strips therefrom; the two parts of the sash thus moving towards and from each other, having springs, or the equivalent thereof, adapted to them, so as to give them a constant tendency to diverge from each other, that the sash may at all times expand promptly, and fill the frame, to hold itself firmly in place, substantially as herein described."

15. For an *Improvement in Milling Machines;* William H. Robertson, Hartford, Connecticut, October 5.

*Claim.*—"What I claim as my invention is, the construction and combination of the vertically moving cutter stock, or poppet head, with the driving pulleys, &c., mounted on a swinging frame, hung with a pivot hinge at the bottom, the connexion between the two being effected by radius rods, in the manner and for the purpose substantially as herein set forth and described."

16. For an *Improvement in Method of Priming Fire Arms;* Christian Sharps, Hartford, Connecticut, October 5; patented in England, April 22, 1852.

*Claim.*—"What I claim as my invention is, the priming of fire arms, by throwing a pellet of percussion or priming material over the nipple, at the time the cock is descending thereon, so that the priming shall be struck down in its flight between the cock and the nipple, and exploded."

17. For an *Improvement in Window Frames;* Henry Clay Smith, Portland, Maine, October 5.

*Claim.*—"What I claim as my improvement is, the pulley style, constructed of the pieces as set forth, in combination with the springs, by which means I am enabled to make use of solid or immovable bead strips and bands, and to remove the sash at pleasure from the frame, in the manner substantially as described."

18. For an *Improvement in Time Pieces;* Silas B. Terry, Plymouth, Connecticut, October 5.

*Claim.*—"What I claim as my invention is, 1st, hanging the balance of a clock or time piece on a spring or strip of metal, which is fixed, or prevented from turning, at both of its ends, but capable of twisting between the ends, substantially as and for the purpose herein described.

"2d, Making one part of the fork or crutch wire flat and thin, substantially as shown at *k*, or otherwise constructing it, to allow it to bend or move in a similar manner, and connecting the said fork or crutch wire with the balance, in any manner, as shown at *i*, which causes it to give its impulse in the same direction as the motion of the balance, the said bending or motion of the fork or crutch, being for the purpose of allowing it to transmit the impulse in the above direction."

19. For an *Improvement in Churns;* Lucian A. Brown and Hubbard Bigelow, Assignors to Henry K. W. Welch, Hartford, Connecticut, October 5.

"The nature of our invention consists in the construction of the churn, in such a manner as to increase the agitation of the cream to be converted into butter, and the adaptation of the churn for "working" the butter after being made, or in other words, extracting the butter-milk and watery parts extant in butter, thereby rendering it more compact and 'firm,' and less liable to become 'rancid.' "

*Claim.*—"Having thus described our apparatus and its operation, what we claim as our improvement and invention is, the combination of the tub, including the appendages described, with the frame and stands, or any other convenient frame work adapted to the use of the tub, in a vertical and horizontal position, but in manner and for the purposes substantially as herein set forth and described."

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## MECHANICS, PHYSICS, AND CHEMISTRY.

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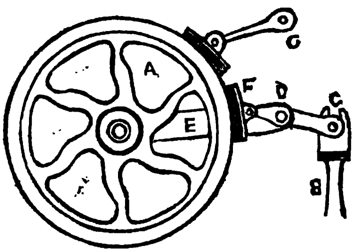
### *Infinitesimal Taking-up Motion for Power Looms.**

Under a recently specified patent for the improved "manufacture of textile fabrics," Mr. Harrison, the well known machine maker of Black-

* From the London Practical Mechanic's Journal, July, 1852.

burn, has described a new "taking-up motion," which has often occurred to ourselves as a most desirable plan for the purpose. Instead of the common ratchet wheel and catches, a small drum or pulley, having its periphery roughened by diamond lines, is used, this drum being actuated by a duplex lever and friction block, on the principle of the friction windlass movements for ships. Our figure represents the apparatus in side elevation. A is the friction pulley, to be driven by the vibration of the rod, B, in any convenient way. This rod is jointed at C, to a short double lever working on a centre at D, in the end of a longer lever, E, which oscillates freely on the stud-centre of the pulley, A. The opposite end of the lever, C, D, has jointed to it a segmental block, F, faced with leather, to work against the pulley's roughened surface. At G is a fixed centre, to which is hinged a detent lever, having a joint friction block like that just described.




As the rod, B, rises, it is easy to see that the species of knee-joint action of the lever, C, D, will cause its friction block to press firmly on the pulley, which is thus carried round as far as the traverse of the rod, B, permits. During this action, the detent lever, G, being set at an angle with a radial line from G to the pulley centre—the reverse of that of the lever, C, D—will allow its block to slip like the back action of an ordinary ratchet detent. As the rod, B, descends for a second stroke, its lever block slips back, whilst that of the detent, G, holds. By the adoption of this movement, the increments of movement of the pulley, A, are not governed by any definite measure, as in the ratchet teeth of the common wheel; and therefore, whatever minute changes are made in the traverse of the rod, B, such change will be accurately conveyed to the pulley, A.

Mr. Macdowall, of Johnstone, has proposed a contrivance of a similar nature for obtaining a silent and minutely adjustable feed for the timber carriage of saw mills. In this, as well as our own adaptation of it to power looms, the pulley is made perfectly smooth, the friction blocks having smooth segmental metal surfaces; for it appears to us that the elastic cushion must, to a certain extent, defeat the great point of the invention—the direct conveyance of the minute changes in the vibratory movement of the driver.

Mr. Harrison effects the required variation in the driver by the increase of the diameter of the cloth beam, in a manner very similar to that adopted by Mr. Milligan. He has also so modified the common ratchet movement, that it is capable of effecting very minute increments of take-up. He does this somewhat on the principle of the "stepped" spur wheel, by using, say 7 catches hung on one centre, and placed parallel to each other, and increasing in length from 1 to 7 by regular gradations, the distance from the end of the first to the end of the seventh being equal to the pitch of the ratchet wheel, which they actuate. By this means the ratchet wheel may be moved to so slight an extent as one-seventh of a tooth, as each tooth is acted on by each individual catch in succession. Precisely

the same effect is produced by using a "stepped" ratchet wheel, that is, a wheel with several sets of teeth arranged obliquely, or in steps across its periphery, as in the wheel and pinion arrangements of screw steamers, one broad catch only being capable of working the whole series.

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*Hints on the Principles which should regulate the Forms of Boats and Ships; derived from original Experiments. By* MR. WILLIAM BLAND, *of Sittingbourne, Kent.*†

Continued from page 277.

## CHAPTER XIII.

Having completed some of the most necessary experiments relative to ships, as a supply of materials for the foundation of the superstructure, a brief recapitulation of the conclusions, before entering upon the construction of a boat or ship upon the principles proved essential to be observed, will, it is considered, simplify proceedings, and therefore be next entered upon.

*Of the Resistance of Water against the Head of a Vessel.*—With a square and perpendicular bow, the resistance is directly as the surface.

*Of Weight—its Effects when placed in a body floating on Water.*—The resistance of water against any increase of weight is directly as the weight.

*Of Lateral Resistance.*—The centre of lateral resistance is exactly at the mid-length point of the keel of a ship when floating level, and at rest; but not otherwise: for when in motion, the head or bow meeting with greater resistance from the water than any other parts, the centre of lateral resistance will be moved proportionately forward.

*Stability.*—This acts when the width is increased one-half, or nearly the cubic ratio; but not afterwards, being as 2, 7, 14, 22. And when the length is added to, the law of stability, if the dimensions be doubled, operates in the proportion of 1 : 3; then, the same quantity of length being continually annexed, it takes the arithmetic ratio. Again, the height or thickness of a body being alone varied, the law of stability operates most when the depth, measured from the line of flotation on the parallel-sided body, equals one-fifth of the width, the centre of its gravity being on a level with the surface of the water.

*The Form of the Bows.*—The conclusions are, that the sharper the form of the bows, the less is the resistance from water; and if gentle horizontal curves be substituted for horizontal straight lines on the sides of the bows, the speed will be improved.

*The Bevelling-up of the Bows.*—The effects of the bevelling-up of the bows are in favor of speed by diminishing resistance.

*The Bevelling-up of the Stern.*—The tapering of the sides throughout the greater length of the body of a ship is detrimental to speed; but if it be commenced at the midship section, and the reduction moderate and a curve, the advantage will be great. The same benefit results when the bottom is gently curved up from the midship to the bows; and, indeed, the effect exceeds that towards the stern.

* From the London Civil Engineer and Architect's Journal, October, 1851.

*Of the Length of Ships, all having the same Bows and Beam, and equal in Weight.*—The result obtained is, if equal increment of length be tested, equal advantages will be obtained on the side of the equal increments.

*The Form of the Midship Section.*—As regards speed, the semi-circular form possesses the most, and the triangular one the least. Again, the flat bottom floats the shallowest, and the triangle the deepest, being double that of the former when of equal weight.

*Lee-Way.*—This property in a ship depends directly upon its perpendicular depth and length at which it is immersed whilst floating upon the water.

*Of Floating Bodies Varied in their Dimensions.*—It appears that the shallower the same weight can be supported upon water, the less the resistance as regards speed; consequently, extended surface of bearing to a certain degree is advantageous towards facilitating progress, and which a moderate curve always imparts. But where an extension of surface-bearing can be obtained without loss of speed, stability becomes directly increased, which is a gain in power to vessels impelled forward by the wind, as it admits of a proportionate increase in the breadth of sail, therefore of speed.

Whilst carrying out these particular experiments, it appeared, if the angles exposed in any way to the water were rounded off, greater speed ensued; but it was generally at the expense of stability, and decidedly so if the pro-sections be low, because the greater is the length of lever from the centre of motion.

Curves were found to favor speed in comparison with straight lines; consequently, the latter are to be avoided as much as possible wherever speed is the object, and the oar and steam are to be the moving powers.

With respect to the general form of ships, experiment decides most positively that the bird or duck species affords the true models for comparison and study, since the forms of fish are so exceedingly various.

## Chapter XIV.

Much has been said upon the comparative speed of several models, likewise of their stability. Now, as stability forms the basis of the power by which the wind, acting upon sails, impels forward the body of a vessel, it will be right to take into consideration and calculation these respective qualifications, as possessed by some few of the models which have been tested. Before doing so, however, since it is evident that those models which equalled or surpassed their competitors in speed, and at the same time had greater stability, will always, under the same weight, run away from vessels of less stability; and if admitted, it will be necessary only to investigate the more extreme cases of both speed and stability, with the exception of one or two instances, when the merits of all the rest follow as a matter of course.

From what has been already ascertained, it appears that when two models of equal weight and similar outline, but one longer than the other, the former invariably had the advantage in speed; consequently, in the following investigations, the calculations had best be confined to models of the same length, but varying in their dimensions of breadth; their weights when tested against each other being always made equal.

Since the models of 28 inches in length are the largest which have been employed, and from their variety of form, though only few in number, they may in fairness be selected for the requisite calculations.

*First.*—Let the model I, in experiment 72, be selected, which is of the bird or wild fowl shape, 4 inches wide and 28 inches long. This, when tested with the model O, in experiment 79, also of the bird form, whose breadth is 5¾ inches, length 28 inches, and the weight 2 lb. 5 oz., gave the following result: the model I, beat in speed the model O, by 12 oz. extra weight. The stability of I, equalled 2½ oz., and that of O, 8 oz.

Now the 12 oz. extra weight may be called one-third of the whole weight moved, being 2 lb. 5 oz. The stability of O, which represents the power of carrying sail, is superior to that of I, in the proportion of 32 : 10, or 3 : 1; therefore say two, which is 74 ounces over and above the model I. This sum is to be set against the one-third of the extra weight of 12 oz., or speed of I, and gives the balance of speed, the sails of each being proportional to their respective stabilities, greatly on the side of O, and equal in ounces to 74—12, or 62 ounces.

The draft in the water of these models, each laden with the extra 12 oz., making 49 oz., was in the model I, 1⅛-inch deep; and in O, ¾-inch; thus proving the boat with greater breadth of beam would, under canvas, be decidedly the best boat of the two.

*Second.*—The next models for comparison are O and P, in experiment 80. These were both 5¾ inches wide, 28 inches long, and each of the weight of 3 lb. 4 oz. In this instance, O proved superior in speed to P by 2 lb. 5 oz. extra weight. The stability of O now equalled 8½ oz., and that of P 12 oz. The extra weight of 37 oz. equalled, say two-thirds of the weight moved.

The stability of P is not quite one-half more than that of O, but let it be so, which sum, if denoted by ounces, will equal 26 oz., and this set against the 37 oz., the extra speed of weight of O, will give the superior speed. When both are placed under sails proportionate to their respective stabilities to the model O, and in ounces equal to 37—26 = 11 oz., meaning when P and O are moving under sail with their speeds equal, O will carry at the same time 11 ounces more than P.

The draft in the water of these two models, when of equal weight, and each having the extra 37 oz., or total of 74 oz., was in O $1\frac{1}{16}$-inch, and in P ⅞-inch.

*Third.*—The model P again made use of to test the model Q, in experiment 81. The dimensions, &c., of P are, width 5¾ inches, length 28 inches, weight made equal to 3 lb. 4 oz. The dimensions of Q are, width 8 inches, length 28 inches, weight 3 lb. 4 oz. The result, as stated in experiment 82, was 20 ounces, which P carried extra to cause its speed to be equal with the model Q. The stability of P equalled 12 oz., and that of Q 21 oz. The extra weight of 20 oz. is two-fifths of 52 oz., the weight of the model. The stability of Q is just one and three-quarters of P, or above that of P by three-fourths of 52, which when reduced to ounces, will be 39, and set against the two-fifths of the extra weight or 20 oz., will give the balance of speed on the side of Q, equal to 19 oz.

These two models, P and Q, sank in the water when each was loaded with the additional weight of 20 oz., or total 72 oz.,—viz: P $\frac{7}{8}$-inch, and Q 1 inch.

The conclusion arrived at is, the superior stability of Q enables it to have the advantage in speed over P, each carrying sail proportionate to their stabilities.

*Fourth.*—From the marked speed of G over P, it will be right to compare its qualities with those exhibited in Q. It has been already shown that the speed of O beat the speed of P by 37 oz.; and P beat Q by 20 oz.; therefore, it will require the sum of the two, or $37+20=57$ oz. extra weight placed in O to retard its speed till it equals that of Q. The weight of each, as before given, equalled 52 oz.; therefore, the extra weight of 57 oz. exceeds it by 5 oz. The stability of O equalled $8\frac{1}{2}$ ounces, and that of Q 21 oz., without the 57 oz. extra. From the above it appears that O has the advantage in speed equal to more than the weight moved; and Q has the excess of stability above O equal to one and a-half its stability; which being reckoned in ounces equals $52+52$ —3 oz., the deficiency=75 oz.; but the extra weight of 57 ounces when taken from 101 oz., leaves 18 oz. in favor of Q, the model with the greatest breadth of beam.

The depth or draft in the water of the models when under the double extra weight of $37+20$, or 57 oz., making the total weight of each 109 oz., was in model O, $1\frac{5}{8}$-inch, and in Q, $1\frac{1}{8}$-inch. The model Q, from its great breadth of beam, would beat the model O, provided, as before mentioned in the preceding cases, the surface of the canvas be proportionate to their stabilities.

*Fifth.*—In experiment 82, the model Q was tested against R. The dimensions of Q are 8 inches in width, 28 inches long, and the weight 5lb. 1 oz.; and those of R, 11 inches wide, 28 inches long, and weight, 5lb. 1 oz., also. Likewise, it is there shown the model Q beat in speed the model R, by 4 oz. extra weight. The stability of Q equalled 24 oz., and that of R 29 oz.

The extra weight of 4 oz. is one-twentieth of 81 oz., and the stability of R exceeded that of Q by 5 oz., which is rather more than one-fifth of 24; and, estimated in ounces, will, in 81 oz., the weight moved, equal 16 oz.; and, minus the 4 oz. extra weight, the measure of the superior speed of Q, leave 12 oz. as the advantage, ultimately, of R over Q. Admitting the above to be correct, then R, under sail, and of equal weight with Q, will beat that, or any other of the same length, but having the beam of less dimensions. The two models, Q and R, sank in the water $\frac{7}{8}$-inch when of the same weight and with the addition of the 4 oz. extra, or total 85 oz.

*Sixth.*—In experiment 83, the model Q was tested against T, the dimensions of these two boats being the same in width, length, and weight. The result of their speeds is also denoted—that T beat Q by 32 oz. The stability of T equalled 16 oz., and that of Q 23 oz.

Therefore, Q has more stability than T, by nearly one-half, being 7 oz., which, if put in ounces, equals $30\frac{1}{2}$ oz. But the extra speed of T was 32 oz.; and, taking $30\frac{1}{2}$ oz., or $32-30\frac{1}{2}$, leaves the sum of $1\frac{1}{2}$ oz. on the side of T, which would in consequence, under equal weight and sails

proportionate to their stabilities, beat Q by the said extra weight of $1\frac{1}{2}$ oz. The models Q and T sank into the water when of the same weight, thus: Q sank $\frac{13}{16}$-inch, and T sank $1\frac{1}{16}$-inch.

The inference which may be drawn from these calculations is, that Q, if lengthened, would beat R; and R, if made longer than Q, would again beat Q. Moreover, if a model, say S, be made of the same proportional length and breadth of R, before lengthened, meaning the breadth at the midship to be two-fifths of the length, but the length of S to equal the length of R, increased, the breadth of S will then exceed the breadth of R, whose length alone had been added to, and therefore would be beaten by S.

## Chapter XV.

It has been seen in the investigations of the preceding chapter, that when any two of these models were of equal weight and equal length, the one with the greatest breadth of beam beat the other. In the experiments on stability numbered 8, and scale C, it is shown when the thickness or depth of flotation is varied, the breadth and length being preserved constant, the greatest stability exists at one-fifth of the beam.

Now, it has been before mentioned in the last chapter relative to the depths of the lines of flotation, that in some instances, as in experiment 80, in I, it exceeded the one-fifth; and in others, as in experiments 81, 82, it was less. Upon testing a few of the models between one-fifth and one-fourth for the line of flotation, the following proved to be the case.

Now, with the models I and O, each having their lines of flotation situated between the one-fifth and one-fourth, which in the model I equals $\frac{3}{8}$-inch, and in O equals $1\frac{3}{8}$-inch, at this depth, the weight of I was required to be increased until it altogether equalled $39\frac{1}{2}$ oz.; and model O equalled 78 oz.

In the experiment No. 80, the models I and O, being then of equal weight, the speed of I beat the speed of O by 21 oz. Under the present circumstances, O exceeds the weight of I by 39 oz.; therefore I has the advantage over O of 21 oz. and 39 oz., or together 60 oz. With respect to the stability possessed by these two models, I and O, it was found upon trial that I in stability equalled $2\frac{1}{2}$ oz.; and O equalled $8\frac{1}{2}$ oz., showing O to have 6 oz., or two stabilities above I, which in weight equals 78 oz.; but take away the 60 oz., and there remains 18 oz. in favor of the model O, when under sail.

Likewise, in the same chapter, it is stated of the models O and Q, that when of equal weight, O beat Q by 64 oz. extra weight. Upon causing the model O to sink in the water until its load line was between one-fifth and one-fourth, it required an increase of its weight, as before given, up to 78 oz.; and Q to equal 152 oz. The stability which each now possessed, was in O $8\frac{1}{2}$ oz., and Q 32 oz.—that is to say, the model Q possesses (let it be granted) two and a-half stabilities above the model O, or in ounces $78+78+39=195$. However, from this sum must be taken the extra weight of Q above O, which is 74 oz., together with the 64 oz. the extra weight in speed, and equalling 138 oz.; or 195—138

=57 oz., which number of ounces is on the side of Q, when under sail proportionate to its stability.

Again, with regard to the models Q and R, that when of equal weight Q beat R in speed by 4 oz. extra weight. It has been mentioned before of the model Q, when the line of flotation was made one-fifth and one-fourth of the beam, that it required the whole weight to be 152 oz. The model R to be similarly circumstanced, required its whole weight to amount to 292 oz.; and the stabilities of these two models was in Q, equal to 32 oz.; and in R 42 oz.; therefore, in the present instance, R has one-third of a stability above Q, which in ounces equals 152÷3=50; but from this sum the extra weight of R above Q must be deducted. Now the weight of R equals 292 oz., and that of Q 152; then 292—152 equals 140 oz., which, with the 4 oz. representing the speed of Q above R, comes to 144 oz. The superior stability of R has been shown to be 50 oz.; therefore, 144—50=94 oz., by which Q beat R in speed.

From the above result it is clear that for the model R to beat in speed the model Q, it will be necessary to place the line of flotation considerably lower than one-fifth, so as to materially lighten the whole weight of R. But upon taking out 96 oz. from R, thus leaving 196 out of 292 oz., the stability of Q, as before, equals 32 oz.; and that of R equals 34 oz.; and R sank in the water with the reduced weight down to $1\frac{1}{1}\frac{3}{8}$-inch, and Q also to $1\frac{1}{1}\frac{3}{8}$-inch. The difference in the present stabilities is 2 oz. for R, which in ounces=152÷32=$4\frac{3}{4}$ for each ounce; and, therefore, the 2 oz. of greater stability=9 oz.; and being taken from 196, or 196—9=187, and 187—152=35 oz. of speed against R.

Again, after lightening the model R until it equalled in its whole weight 152 oz., the same as the model Q, the stability of R was now tried, and found to equal 32 oz., equalling that of Q; and R sank only to $1\frac{3}{8}$-inch.

It has been previously mentioned Q beat R in speed when they were of the same weight, by 4 oz.; consequently, their stabilities being now the same, Q will, under sail, again beat R. Before, however, the result was quite contrary, as R by its superior stability beat Q. This being the case, it then appears for R again to beat Q, more weight must be removed out of R; that is to say, until it is of the same precise weight as it was, as in experiment 83, namely, 81 oz. instead of 152 oz.

When the models Q and T were made to sink down into the water to the depth of between one-fourth and one-fifth of their midship breadth, the weight was required to be increased till it amounted in the total of the model Q, as before given, to=152 oz.; and that of T to=140 oz.

In consequence of the above additional weight, the stability of T equalled 18 oz.; and that of Q 32 oz.

It appears, then, from these stabilities, that the model Q has the advantage over T to the amount of three-fourths of a stability, and which, if put into ounces, equals 105, the stability and weight of T. Q exceeds T in weight by 152—140=12 oz.; but the extra speed of T over Q=32 oz., which sum must be deducted also; then Q beats T in speed, when both are under sail, by the number of 105—12—32=61 oz.

I.—Table *of the difference of the Speed between the six Models when Towed through the Water.*

| Model. | Shape. | Beam. | Weight. | Result. |
|---|---|---|---|---|
| | | INCHES. | OUNCES. | |
| I | Bird. | 4 | 37 | O beaten by 21 ounces. |
| O | Bird. | 5¾ | 37 | |
| O | Bird. | 5¾ | 52 | P beaten by 27 ounces. |
| P | Oblong. | 5¾ | 52 | |
| P | Oblong. | 5¾ | 52 | Q beaten by 20 ounces. |
| Q | Oblong. | 8 | 52 | |
| O | Bird. | 5¾ | 52 | Q beaten by 64 ounces. |
| Q | Oblong. | 8 | 52 | |
| Q | Oblong. | 8 | 81 | R beaten by 4 ounces. |
| R | Bird. | 11 | 81 | |
| Q | Oblong. | 8 | 70 | Q beaten by 32 ounces. |
| T | Bird. | 8 | 70 | |

I is the swiftest, O the second, T the third—all of the bird shape.

II.—Table *of the difference of Speed between the six Models when considered under Sail proportional to their Stabilities, and carrying a light Load.*

| Model. | Shape. | Beam. | Weight. | Depth. | Stability. | Result. |
|---|---|---|---|---|---|---|
| | | INCHES. | OUNCES. | INCHES. | OUNCES. | |
| I | Bird. | 4 | 37 | 0 15-16 | 2½ | I beaten by 62 ounces. |
| O | Bird. | 5¾ | 37 | 0 11-16 | 8 | |
| O | Bird. | 5¾ | 52 | 0 15-16 | 8½ | P beaten by 11 ounces. |
| P | Oblong. | 5¾ | 52 | 0 6-8 | 12 | |
| P | Oblong. | 5¾ | 52 | 0 6-8 | 12 | P beaten by 19 ounces. |
| Q | Oblong. | 8 | 52 | 0 5-8 | 21 | |
| O | Bird. | 5¾ | 52 | 0 15-16 | 8½ | O beaten by 8 ounces. |
| Q | Oblong. | 8 | 52 | 0 5-8 | 21 | |
| Q | Oblong. | 8 | 81 | 0 7-8 | 24 | Q beaten by 12 ounces. |
| R | Bird. | 11 | 81 | 0 13-16 | 29 | |
| Q | Oblong. | 8 | 70 | 0 13-16 | 23 | Q beaten by 1½ ounces. |
| T | Bird. | 8 | 70 | 0 7-8 | 16 | |

The model R is the swiftest under sail with the light load, T the second, and Q the third—Q being of oblong form, R and T of the bird shape.

III.—Table *of the difference of Speed between the Models when supposed to be under Sail proportionate to their Stabilities, and so Loaded as to draw between one-fourth and one-fifth of their Beams deep in the Water.*

| Model. | Shape. | Beam. | Weight. | Depth. | Stability. | Result. |
|---|---|---|---|---|---|---|
| | | INCHES. | OUNCES. | INCHES. | OUNCES. | |
| I | Bird. | 4 | 39½ | 0 7-8 | 2½ | I beaten by 18 ounces. |
| O | Bird. | 5¾ | 78 | 1 3-8 | 8½ | |
| O | Bird. | 5¾ | 78 | 1 3-8 | 8½ | O beaten by 57 ounces. |
| Q | Oblong. | 8 | 152 | 1 13-16 | 32 | |
| Q | Oblong. | 8 | 152 | 1 13-16 | 32 | R beaten by 94 ounces. |
| R | Bird. | 11 | 292 | 2 1-2 | 42 | |
| Q | Oblong. | 8 | 152 | 1 13-16 | 32 | R beaten by 35 ounces. |
| R | Bird. | 11 | 196 | 1 5-8 | 34 | |
| Q | Oblong. | 8 | 152 | 1 13-16 | 32 | T beaten by 61 ounces. |
| T | Bird. | 8 | 140 | 1 13-16 | 18 | |
| O | Bird. | 5¾ | 78 | 1 3-8 | 8½ | P beaten by 6 ounces. |
| P | Oblong. | 5¾ | 84 | 1 3-8 | 12 | |

The model Q is the swiftest under sail, when full loaded, and T the second—the oblong, in this instance, being the best.

IV.—Table *showing the proportion of the Beam the depth of flotation ought to be for the greater Speed, with bottoms quite flat, and impelled forward by the Wind on Sails proportioned to their Stability.*

| Model. | Shape. | Beam. | Weight. | Depth. | Stability. | Proportion of depth to the beam. | Proportion of breadth to the length. |
|---|---|---|---|---|---|---|---|
| | | INCHES. | OUNCES. | INCHES. | OUNCES. | | |
| O | Bird. | 5¾ | 50 | 0 7-8 | 8½ | One-seventh | 5 |
| Q | Oblong. | 8 | 152 | 1 13-16 | 32 | One-fourth. | 3½ |
| R | Bird. | 11 | 81 | 0 13-16 | 29 | One-fourt'h. | 2½ |
| T | Bird. | 8 | 70 | 0 7-8 | 16 | One-ninth. | 3½ |
| I | Bird. | 4 | 20 | 0 9-16 | 2½ | One-seventh | 7 |

Upon a review of these tables, it will be seen that a maximum of weight and speed is incident to some form of the models, and not to others. This circumstance is most apparent in the long bird or fish shapes, since their stabilities cease to increase with additional weight, after it amounts to a certain quantity; that quantity, therefore, may be denominated the limit or maximum. But with the oblong model Q, and the duck shape model R, any increase of their weight is attended with an increase of their stability also. However, it is seen of the model Q, that with the increased stability, consequent on the additional weight, the speed is not so retarded by it as the model R, and the other models; therefore, advantage can be taken of this peculiarity for all ships intended for burthen.

(To be Continued.)

## *Casting in Bronze.**

On Saturday last we spent some hours at the foundry of Mr. Robinson, in Pimlico, for the purpose of being witnesses to the new process of casting in bronze, by which works of great size and importance are moulded entire, instead of piecemeal as of old. Every multiplication of the acts by which a work of Art is to be transferred from its original Art-language into another increases, it will be obvious, the risk of some sacrifice of the author's intentions or proportions; so that Mr. Robinson's new method, by which a single act of translation is made to suffice, is at once a simplification and a most valuable improvement. Our readers may remember that the first experiment on a large scale was made with Mr. Behnes's Peel statue for the town of Leeds,—and the success was such as to establish the process for future great works. In the present case, the subject was the fine statue, upwards of ten feet in height, which Mr. Baily has modelled for Sir Robert's native town, Bury, in Lancashire. Of old, the casting of large pieces, even when such works were divided, took place in pits dug to contain the mould,—and the legs and trunk would have received the burning stream which was to harden to immortality within them in upright posture. On the present occasion, a huge iron case, strongly bound and riveted, had been built on the surface of

* From the London Atheneum, July, 1852.

the floor, of dimensions to receive the full-length figure in a horizontal position. Close at hand glowed and roared the huge furnace in which the fusion of metals was, under the compelling power of a heat intensified into almost invisibility, for hours going on. When this process of fusion was accomplished, the mixed metal, to the weight of more than two tons, was received into an iron cauldron, and swung by machinery to the case which enshrined the mould. In the black sand that formed the roof of this case and of the mould there was one great vortex for the reception of the flaming material,—and from this, channels running in all directions to convey it horizontally to every part of the figure at once. Here, the liquid flame was skimmed; and after a few minutes of breathless pause, under the influence of strong excitement to ourselves, and of deep anxiety no doubt to those more immediately concerned—the final signal was given. The cauldron was turned over at the mouth of the vortex by the machinery from which it swung—and in thirty seconds by a stop-watch, the Bury 'Peel' was cast! The thing was like the creation of an enchantment. The workmen at once proceeded to the task of knocking away and uncovering; —and the result is, a cast of surpassing beauty—almost perfect from the mould itself—and scarcely needing the chaser's hand.

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## *The Screw and Paddles Combined.** By J. Bourne, C. E.†

I am not aware that there are any vessels in actual existence which are propelled by the conjoint action of paddles and a screw, but some years ago I proposed the establishment of vessels of this kind, under circumstances which it will require a slight digression to recite.

The Peninsular Steam Packet Company, of which the Peninsular and Oriental Steam Packet Company is a subsequent extension, was established by my father, the late Captain Bourne, who advanced more than half the capital necessary for the establishment of the company himself, while the residue was chiefly contributed by his brothers and other members of his family. The *Tagus*, *Braganza*, and other original vessels of the company were constructed under my direction, and they were generally considered to the best vessels of their time; but for many years I have ceased to have any further connexion with the company than is implied in an interest in its success, and a desire to see it prosper. For some years past, however, its original reputation has been on the decline; the original vessels had become old and slow, and some of them had been lost, while the new vessels which had been added to the company's fleet, instead of being better than the old, were in most cases worse, so that the *prestige* with which the company started was no longer maintained.

The result of this state of things was, that various proposals for establishing a rival company were entertained; and it became obvious to me that, if a rival company were established, one of two consequences would ensue—either the new company would get the mails to carry, or if the old company succeeded in retaining them, it would only be after such a

* From Treatise on the Screw Propeller, by J. Bourne.

† From the London Artizan, August, 1852.

keen competition, and on such stringent conditions, that the service would hardly repay any contractor. Under these circumstances, I communicated with my father, who was then still living, and with some of the other directors of the company, pointing out the course which it appeared to me ought to be pursued under the circumstances related; and my recommendations were to the following effect.

It was quite clear that the very general dissatisfaction which had been expressed at the want of power and speed in the company's vessels was not unfounded. Here was a line, confessedly the most important of all our lines of postal communication, on which the vessels built ten or twelve years before were still the best, the more recent vessels being, for the most part, exceedingly slow and inefficient, when compared with other successful vessels of recent construction. It was quite indispensable, therefore, in order to meet the just expectations of the public, that vessels capable of maintaining a higher rate of speed should be introduced; and as the introduction of such vessels by some party or other was inevitable, it would not be advisable to postpone the improvement until the attempts of rival parties had been so far organized, that competition could no longer be averted by any expedient of amelioration. All this was very clear; but the question at once arose, what was to be done with the existing vessels? Attempts had been made to accelerate some of them by the application of feathering wheels, but with very inadequate results; and all attempts at petty improvements appeared to me not only futile, but injudicious, as such attempts involved a considerable expense, and practically left the vessels still unequal to the exigencies of their vocation. Now, seeing that it would be impossible to sell the existing vessels without immense sacrifice, and that it would be equally impossible to retain them, unless a radical change in their efficiency could be effected; and seeing, too, that the usual means of acceleration had been tried, at a heavy expense, but without any material benefit, it occurred to me that, upon the whole, the most judicious course would be to introduce into each vessel a separate engine, which would drive a screw, working in the stern of the vessel, in aid of the paddles; and by this arrangement it was obvious that any increase of power and speed might be given to the existing vessels that the exigencies of the case required. I recommended, therefore, that one of the smaller vessels of the company, the *Madrid*, for example, should have a screw fitted at the stern, to aid the operation of the engines; and I found that a pair of screw engines, of the same power as the existing paddle engines, of 140 horse power, could be supplied for about £800; the screw engines being light and cheap, as they would be without air pumps and condensers, and would be connected immediately with the screw shaft. If the result answered the expectations formed of it, a similar arrangement could, it was obvious, be introduced into the larger vessels without any very great expense, and those vessels would thus be enabled to maintain a rate of speed exceeding anything then existing in ocean steam navigation, and the dilemma in which the company stood of having to discard their present vessels, or lose the mail contract, would be dissolved.

This suggestion has met with the same reception and the same fate as that which I had previously made for the better ventilation of the vessels.

At first it was looked upon in the light of a great deliverance; but it has since been suffered to languish and die out, my father's advanced age, and subsequent illness and death, having prevented him from taking those active steps for its furtherance which otherwise he would have felt called on to pursue. The mechanical part of the question was referred to Mr. Penn for his opinion, whose views completely coincided with my own, the only difference being, that he stated them with greater clearness and force than I should have been able to do. Other leading engineers to whom the proposed arrangement has since been mentioned concur in the conclusions at which I had arrived. As every one of ordinary engineering attainments will be able to form a judgment for himself upon this subject, I shall here recount the nature of the intended arrangements, and the extent of the benefit which, according to my estimate, would have been obtained.

I have already mentioned, that if the power of any given vessel be doubled, her speed will be increased nearly in the proportion of the cube root of 1 to the cube root of 2. A vessel, therefore, which maintains a speed of 10 knots with any given power, will maintain a speed of about 12½ knots with twice the power; and I proposed that the power of all the Company's vessels running on important lines should be doubled wherever the usual speed did not exceed 10 knots an hour. Now this duplicature of the power I proposed to accomplish without touching the existing engines at all, and, as I have already mentioned, I proposed to apply a screw in the stern of the vessel, which was to be driven by separate direct acting engines of its own. The screw engines would not have had either air pumps or condensers; but the steam from the boilers was to enter the screw engines first, and after having given motion to them, would have passed into the paddle engines, where it would have been condensed in the usual manner. By this arrangement, the steam would have been used twice over, and twice the amount of engine power would have been exerted in the hour, without any increase in the consumption of coal. To enable these arrangements to be carried into effect, it would be necessary to work with a higher pressure of steam than has heretofore been employed in these vessels; and I proposed to use a pressure of about 25 lbs. on the square inch, which was about three times the pressure then employed. To enable this pressure to be used with perfect safety, I proposed that the boilers should be circular—such as Mr. Penn has since put into the *Hydra*, which may be worked up to 30 or 40 lbs. on the square inch, if required. It would, of course, be impossible to put any such pressure as I proposed to use upon the existing paddle engines, as it would have broken them down; but the steam was to act, in the first instance, upon the pistons of the screw engines, after having given motion to which, it would pass into the paddle engines, and be there condensed in the usual manner. There is, therefore, only the same quantity of steam to be generated under the new arrangement as under the old, and it would be generated, of course, with the same quantity of coal: but after having been employed in the cylinders of the screw engines, and been there expanded down to that point of elasticity with which the paddle engines at present work, it was to be conducted into the paddle engines, and to work them in the same way as if steam of that elasticity had come direct from

the boiler. The proposed arrangement, therefore, is analogous to that of a Woolf's engine; but as the engines employed to drive the screw would work at a high velocity, they would be smaller than the high pressure cylinders of a Woolf's engine, in the proportion of their increased speed.

It will be obvious, from the exposition I have given in the foregoing pages of the mode of action of the screw in the water, that a screw acting in aid of paddles would work far more efficiently than if it were employed alone to propel a vessel; for, as the vessel is at all times moving through the water from the action of the paddles, the screw will always have a column of water of a considerable length to act upon at each revolution, and the slip will be diminished in consequence. And as, by the operation of the paddles, the action of the screw is amended, so will the action of paddles be amended by the action of the screw. For, since the vessel will pass faster the water when an auxiliary screw is added, the paddles will gear into a greater length of water in a given time, which, as it will possess more inertia without any more pressure being employed to move it, will be operative, to a corresponding extent, in reducing the slip of the wheel. In fact, both propellers will act constantly under the same favorable circumstances as if the vessel were always sailing with a fair wind; for the screw is virtually a fair wind to the paddles, and the paddles are a fair wind for the screw.

It will be further obvious, that by adding to a paddle vessel screw engines of the same power as the paddle engines, the total power of the vessel will be somewhat more than doubled; for, when the speed is increased from 10 to 12½ knots, the speed of the paddle engines will be increased also, so that they will give out a fourth more power than before; and the increased speed of vessel due to this small increase of power will, in its turn, somewhat increase the speed and power of the screw engines. But this increase of the power I have not thought it necessary to reckon, seeing that it would only be obtained with an increased consumption of fuel, and that the speed of the vessel will not increase quite so rapidly as the cube root of the augmented power. Now, if the speed of the vessel be increased one-fourth, and the consumption of fuel, per hour, only remains the same, it is clear that the vessel will require one-fourth less fuel for the accomplishment of a given voyage. Instead, therefore, of the vessels employed upon the Indian line having to carry about 600 tons of coal, they would only require 450 tons for the performance of the same voyage under the proposed arrangement, and the weight thus saved would fully compensate for the extra weight of the screw engines and screw.

From these considerations it appears, beyond doubt, that, by the proposed mode of acceleration, about one-fourth more speed would have been obtained with a smaller consumption of fuel, and without any increased weight in the vessel. The only topic remaining for consideration is, whether boilers using such a pressure as 25 or 30 lbs. would be quite safe in steam vessels, seeing that the boilers of steam vessels sometimes get incrusted with salt, when, possibly, the furnaces may get red hot. Now, it is quite clear that any boiler which is suffered to get red hot, from whatever cause, will be productive of danger; but such an occurrence is a very rare one; and I consider that the risk of salting may be obviated by an expedient mentioned to me by Mr. Penn, as a suggestion of

Mr. Spiller's, and which appears to me to afford a perfect security against the danger. This expedient consists in the application of a feed pump, which is purposely made too large to supply the quantity of water requisite for the generation of the steam, and which is not provided with any means of shutting off the water, or allowing the surplus to escape. It will follow, consequently, that a good deal more water will be sent into the boiler than what can be raised into steam, and the surplus must be blown out by the engineer; or a self-acting float may be applied to the boiler, to permit its escape when the level of the water rises above a given point. With this simple provision it will be impossible that the flues of the boiler can ever become incrusted to an inconvenient extent, whether the boiler is leaky or not; and any objection based upon the supposition of such a possibility must of course disappear when the possibility itself no longer exists. The question, however, is not so much whether boilers with a pressure of 25 or 30 lbs. may be made as safe as boilers of a much lower pressure, but whether they may be made as safe as boilers with nearly the same internal pressure, but which are by no means adapted to sustain it. In modern sea-going steam vessels, 20 lbs. on the square inch is a frequent pressure; and in a few instances the pressure is as high as 25 lbs. These boilers, nevertheless, have flat sides, and depend for their strength upon stays, which after some time corrode, and may even be eaten through, leaving the boiler in a very unsafe state. The pressure, indeed, is always reduced in these vessels, as the boiler gets into a state of dilapidation; but such an adjustment rests the responsibility of the safety of the boiler upon the engineer, and is a practice likely to lead to accidents. Instead, therefore, of loading the boiler at the first to its maximum strength, and gradually reducing the pressure as it gets into disrepair, it appears to me to be by much the safest course to make the boiler of such a construction, at the outset, as to enable it, without the aid of stays, to withstand a very much higher pressure than is put upon it; and it will then continue to be safe even when old and worn. This, accordingly, is the course which I proposed to pursue, and it still appears to me to be the most eligible that could be adopted.

These comments have extended themselves to such a length, that the remarks I have to offer respecting the comparative advantages which vessels propelled both by the screw and by paddles would offer relatively with those presented by vessels propelled by either screw or paddles alone, must be despatched very summarily. It is only in the case of vessels intended to maintain a high rate of speed, upon voyages of considerable length, that I would propose to employ both the screw and paddles; but in those cases the combination has very obvious advantages, if the comparison be made with that measure of efficiency which screw and paddle vessels have heretofore respectively attained. Paddle vessels, when deeply, are unable to exert their power with good effect; whereas, under those circumstances, the screw acts in its best manner. On the other hand, a screw vessel set to encounter a head wind wastes much of the engine power in slip; and the performance would be improved, under such circumstances, if half the power were withdrawn to work paddles, since not only would the paddles act in such a case with great efficiency, but the advance they would give to the vessel would enable the screw to

act with greater efficiency also, as it would be perpetually coming into a fresh body of water, whereby the slip would be reduced. A vessel, therefore, propelled by paddle engines of 500 horse power, and by screw engines of 500 horse power, would be more efficient, when deep, than the same vessel propelled by engines of 1000 horse power driving paddles; and more efficient, when set to encounter head winds, than the same vessel propelled by engines of 1000 horse power driving a screw. In fact, by the proposed combination, a higher average measure of efficiency would be attained, and in so far as the screw engines would be lighter and more compact than paddle engines of the same power, a further benefit to that extent would be obtained also. The paddles, moreover, would not require to be of such inconvenient dimensions as if the whole power had to be transmitted through them, and yet a very effective hold of the water would be obtained. Should either the paddles or the screw be deranged by any accident and be unable to work, the vessel would still be able to proceed by the remaining instrument of propulsion, at a diminished rate of speed. Upon the whole, therefore, I am of opinion that vessels constructed on this plan will be better than if propelled solely by paddles, and they will be better also than vessels propelled solely by the screw, if the mode of applying the screw be the same as that which has been heretofore in use; but they will not be better than vessels propelled solely by the screw, if the screw be applied in the manner I have recommended, so as to enable screw vessels to proceed in an efficient manner against a head wind. It is mainly, however, as a means of accelerating the speed of existing paddle vessels that the plan is to be recommended, and I do not know of any mode by which an effectual measure of acceleration can be ensured with so small a disturbance of the existing mechanism, and at so small an expense. In reflecting upon the various means of accelerating vessels, when I first entered upon the consideration of this subject, other modes, as may be supposed, suggested themselves of accomplishing the same object. One of these modes was the use of feathering wheels, and the reduction of the diameter of the wheels, so that a higher velocity of the engine would be obtained. But this expedient, it was obvious, would only fall into the category of petty ameliorations, since it would be impossible to reduce the diameter of the wheel very much in vessels of a varying immersion without introducing other evils; and it did not appear advisable, moreover, to increase the speed of the engines very much beyond that at which they then worked, as many of the arrangements were not suited to a high velocity. Another idea was to interpose gearing between the engine and paddles; but this expedient had much the same objections as the preceding; and if either of these plans could have been carried into effect, it would have been necessary to increase the area of the floats in the proportion of the increase of power, else the slip would have been augmented. In both of these plans, moreover, the consumption of fuel would have risen in the same proportion in which the power was increased; whereas, by the application of an auxiliary screw in the manner I contemplated, the increase of the power would not have occasioned any increase in the consumption of fuel per mile, but would have been less than before. In all cases, therefore, in which it is desirable to increase largely the speed of

a paddle vessel, that object will, in my judgment, be best attained by the introduction of an auxiliary screw worked by direct acting engines, which receive steam of a considerable pressure from boilers of appropriate construction, and transmit the steam in an expanded state to the paddle engines, to be there condensed in the usual manner.

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*Explosions in Coal Mines.—Report from the Select Committee of the House of Commons, appointed to inquire into the Causes of the frequency of Explosions in Coal Mines.* (*Ordered, by the House of Commons, to be printed June 22d,* 1852.)*†

The Committee, considering the pressing emergency of the matter committed to their charge, how deeply the interests of humanity were involved, (the deaths from explosions having latterly increased to the fearful number of about 1000 per annum,) determined only to examine witnesses of the highest and most experienced character, in the hope that they might be able to derive sound information, on which to recommend additional means for the prevention of such wide-spread calamities during the present session. The Committee are therefore of opinion—

That any system of ventilation depending on complicate machinery is unadvisable, since under any disarrangement or fracture of its parts, the ventilation is stopped or becomes less efficient.

That the two systems which alone can be considered as rival powers, are the furnace and the steam-jet.

The *furnace* system, under favorable circumstances—*i. e.*, of area of the shafts being large and deep, the air-courses sufficient, the goaves (or old workings) well insulated, and the mine not very fiery, appears to be capable, with strict attention, of producing a current of air that will afford reasonable security from explosion; but when the workings are fiery and numerous, as well as remote, and the intensity of the furnace or furnaces requires to be raised in order to increase, on any particular emergency, the amount of ventilation, then the furnace not only refuses to answer the spur and to increase ventilation, but from a natural law, (discovered by Mr. Gurney, and scientifically and practically confirmed before the Committee,) there arises a dangerous stoppage to ventilation going on throughout the mine.

The quantity of heat generated by the furnace is directly as the quantity of fuel that can be consumed in a given time. The amount of rarefaction or power of the upcast will always be directly as the temperature of the column of air passing up in a given time, which temperature will vary in proportion to the quantity. The amount of heat of the furnace is a constant quantity, which will be spread over a more or less quantity of air. The power of the upcast rising in *an arithmetical ratio;* the friction or drag of a current of air through the workings of a coal mine, offering a

* We have thought it necessary at present to give only the leading features of this Report, but shall probably return to the subject when the Minutes of Evidence given before the Committee are made public.—Ed.

† From the London Civil Engineer and Architect's Journal, July, 1852.

resistance, equal to the *squares* of its velocity. Now it is manifest there will soon be a point where the resistance overtakes the power. The power being as an arithmetical ratio, while the resistance increases in a geometrical ratio, the "furnace limit" will be the point where these two powers balance each other. This limit commences in practice much earlier than would appear on calculation from these data, because there is another element to be taken into calculation that seems never to have been noticed. This element is the resistance offered to the air going through a mine by the *vena contracta.* It amounts to a serious quantity in the workings of an ordinary coal mine. This amount of extra resistance, added to the friction arising from the rate of current, adds considerably to the rate of increase of the drag. This important fact has never hitherto been noticed; nor was it referred to by any of the witnesses in the Committee of 1835, or that of the Lords in 1849.

The resistance or drag of a current of air passing through the working of a coal mine is, as stated above, as the squares of its velocity. When this resistance is so great that the proper quantity of air cannot come through the galleries of a mine to fill the exhaustion produced at the bottom of the upcast-shaft, it will come down through the shaft itself, as the easiest channel. It will come down on one side, leaving room on the other for the hot air to ascend, the stationary particles of air between the two moving currents forming an imaginary aerial plate. The plate has been called the "natural brattice."

The amount of resistance of currents of air coming through the workings, increase as the *squares* of their velocity; the power of exhaustion by the upcast-shaft is *directly* as its temperature. If the quantity of air passing through a mine be reduced by increased friction or obstruction, that smaller quantity of air will be raised to a higher temperature by the furnace in the up-shaft, and the exhaustion arising from its increased temperature will produce a greater amount of *force.* The water gauge is a measure of this force of exhaustion or power of the furnace. Under the above circumstances, the water gauge will rise and indicate a *greater power*, while the *amount* of ventilation is reduced. This is a seeming fallacy: it is not a fallacy; therefore, is called the "furnace paradox."

To the powers of the *steam jet*, on the other hand, there appears to be no practical limit; for although it acts, when placed (where recommended) at the bottom of the upcast, as a rarefier to the extent of the steam used, and fire under the boiler, its principal or direct efficiency depends upon its power of propulsion. The heated air not only rises from rarefaction, but any amount of cold air can be bodily pushed up the upcast, the amount merely depending on the number and size of jets employed, and the pressure of steam. The Committee are unanimously of opinion that the steam jet is the most powerful, and at the same time, least expensive method for the ventilation of mines.

Previous to 1848, when Mr. Forster introduced the steam jet into the Seaton Delaval mine, the fire-damp was constantly seen playing around the face and edges of the goaves and other parts of the workings; since that period the mine is swept so clean that it is never observed, and all danger of explosion seems removed in a very fiery mine. The increase of ventilation is from 53,000 cubic feet per minute under the furnace

system to 84,000 under the steam jet; and to double that quantity, which Mr. Forster considers sufficient, would, he says, only require the application of some extra jets. Mr. Forster states the original outlay for the steam jet to be less than for the furnace by £39 15*s.* 6*d.*; and the annual cost to be less by £50 12*s.* 1*d.*; while the power of ventilation is increased to nearly double.

Notwithstanding the increase of ventilation which Mr. N. Wood states he has obtained in one of his collieries, where the areas of the shafts are very large, and by the aid of three furnaces, it appeared in evidence that the explosion at the Killingworth Colliery last autumn, under Mr. N. Wood's management, took place under the furnace system of ventilation.

Although a few of the witnesses (two of the most intelligent of the government inspectors among the number,) seemed to have misunderstood the mode in which the steam jet operated as a ventilator, and professed themselves so far unacquainted with it as to be unable to form an accurate judgment on its merits, all the witnesses, with scarce an exception, coincided in the opinion that in a fiery mine, even where the furnace system was thought sufficient under ordinary circumstances, it would be a prudent and almost necessary precaution to have a steam jet apparatus at the top of the downcast connected with the boiler of the engine which worked the mine, in case a sudden and great increase of power was required, under pressing emergency.

It was stated in evidence that 70 per cent. of the deaths from explosions were occasioned not by the explosion of fire-damp, but by the "after-damp" which succeeds it. If the latter be inhaled in its pure state by the miner, it causes immediate death. But since, from the miners being subsequently discovered in various stages of prostation, it is apparently inhaled in various degrees of dilution, it seems clear that a power like the steam jet placed at the top of the downcast, out of reach (which the furnace at the bottom of the upcast occasionally is not) of the effects of the explosion, and capable of sweeping the galleries of the mine with an almost irresistible force immediately after the explosion, might be the means of saving a large proportion of the lives now lost for want of such a power. The furnace under such pressing emergency is inapplicable, and incapable of being used for the purpose.

The Committee, however, are unanimously of opinion, that the primary object should be to prevent the explosions themselves; and that if human means (as far as known) can avail to prevent them, it is by the steam jet system as applied by Mr. Forster; although even in such case it might be prudent in a mine especially fiery to add an inexpensive steam jet apparatus at the top of the downcast, as a means in reserve in case of explosion from neglect or otherwise.

The proper condition of a mine, as regards its ventilation, the Committee consider is when the current of air through all the air courses, more particularly in the extreme workings, is from four to six feet per second in rate through an ordinary sized air-way, of (say) 50 feet sectional area; this, in the extreme workings, would command a rate of current to a much greater extent (and which would be necessary) through the less remote workings of the mine. Without a current of air at the rate of at

least four feet per second, equal to about three miles per hour, in *every part* of a mine at all fiery, the miner cannot be considered safe from explosion. Such current would be the truest indication of the actual amount of fresh air circulating through the general workings of the mine. It seems immaterial by what mode this rate of current is produced, so that it be certainly produced, and a means be furnished to the inspector at each visit to ascertain that such rate of current has constantly existed during his absence.

The attention of the Committee has been directed to scientific and practical means of decomposing or neutralizing the explosive gases as they exude from the coal and goaves; but it does not appear that science has discovered any practical means for producing this desirable effect. Mr. Blakemore, M. P., has offered, through the Royal College of Chemistry, a premium of £1000, for the discovery of some simple practical means for the attainment of this important object.

The Committee would now refer to some more incidental means of security against explosion; first, stating their concurrence in the opinion expressed, directly or indirectly, by the Committees of 1835 and 1849, and also with that so strongly expressed by the South Shields Committee, that where a proper degree of ventilation does not exist in a mine, the Davy-lamp, or any modification of it, must be considered rather as a lure to danger than as a perfect security. Practically secure in a still atmosphere, it may be considered; and in the hands of a cautious over-man, an admirable instrument for exploring, or as an indicator of danger; but in a current, as admitted by its illustrious inventor himself, it is not a security; and in the hands of an ordinary workman, under circumstances of excitement, when danger is threatened, it is not improbably, far oftener than imagined, the very cause of the explosion which it is intended to prevent. The experiments of Dr. Bachhoffner, at the Polytechnic Institution, before the Committee, were very interesting on this point. Nevertheless, in a mine that is at all fiery, it will be a prudent precaution to work with a lamp, until it can be proved that by means of ventilation a mine can be so far cleared of all explosive gases as to prevent any accumulation of them in the workings, goaves, or elsewhere. Some of the witnesses point to such a possibility; and if it were for the sake of the health of the miners alone, a current of fresh air passing through the mine which could produce this effect, would render such a power one of the most valuable contributions of the age. One of the principal objections to the Davy-lamp, on the part of the workmen, has been the insufficient light which it affords. A lamp of greater reflecting power, which would at the same time admit of a double gauze protection, has been suggested. It is made of polished wire gauze, instead of black iron wire. The latter has an absorbing surface, the former has a reflecting one; the latter intercepts and obstructs more than half the light given out by the flame; the reflecting lamp reflects the light which falls on the meshes of the wire gauze, and sends the rays out on the opposite side, in a profitable direction.

In the furnace system of ventilation, the power depends on the difference of the temperature of the air going down the downcast shaft and that coming up the upcast; and when the temperature of the outer air is high, the power of the furnace is reduced. When the thermometer, there-

fore, exhibits a high rate of temperature, the ventilation is lessened. This may account for accidents being generally more frequent in spring and summer.

Under the ordinary pressure of the atmosphere, its weight operates in a fiery mine to keep back the escape of gas from the recesses of the mine. When the pressure is less, the explosive gases have greater power of escape. Whenever, therefore, there is a fall in the barometer, showing a diminished pressure of the atmosphere, danger is indicated, and an increased amount of ventilation required. In every mine, therefore, it should be imperative for a barometer to be kept. It should be placed near the ventilating power, properly connected with the external air, through the downcast, so as to take the pressure of the atmosphere. A "Differential Barometer" is much more sensitive than a common one, and should be used; and since it costs only a few shillings, there would be no excuse for not having one. The differential barometer, so called, is more delicate in its movement than an ordinary barometer; it may be made almost to any ratio of delicacy. It would show a change taking place in the weight of the atmosphere long before it could be seen in the ordinary barometer, and therefore be highly valuable in a coal pit. On the fall of the barometer, fire-damp issues out of the goaves and recesses of the coal in larger quantities than usual, so that ventilation requires to be increased under such circumstances, and the fall in the barometer points it out before it can be otherwise seen. The barometer is said to be more useful in a coal pit than in a ship. It indicates impending storms, or change of weather, and the more delicate it is the better. The index of the differential barometer can be made to range from 50 to 100 times through a greater space than the ordinary mercurial level; and therefore slight changes in the weight of the atmosphere can be read off by this instrument, which are invisible or inappreciable in the common barometer.

A water gauge should be placed at the bottom of the upcast, to indicate the power of the drag of the mine, where the furnace is used, so as to indicate the proximation of the furnace limit. The water gauge is a tube of glass bent in the form of the letter U, one end of which communicates with the upcast and the other with the downcast shafts by a pipe; it contains a little water at the bottom of the bend, and is an indicator of the *amount of power;* its extent of break of level in the two legs is a measure of the actual *force* which is necessary to overcome the "drag of a mine." When this force is known, its rise or fall indicates whether proper ventilation is going on in the extreme workings or not; thus if the air comes through the workings by a shorter passage than it ought to do, the water gauge will immediately fall. In a late explosion, occasioned by leaving a door open between the downcast and upcast shafts, the water gauge would have pointed it out. If the water gauge rises above its working point, it shows obstruction existing somewhere in the workings. If it stands at its working point, it shows that ventilation is going right. It is a most useful instrument; it is a measure of the actual power required for ventilation, and in the possession of a practical man, will tell him where and how ventilation is going on by simple

inspection. In connexion with the anemometer, this gauge is most valuable.

But an instrument of even greater importance than the above, especially in reference to the periodical visits of inspectors, is a self-registering anemometer, by which the inspector would know at each visit the rate at which the current of air had been passing through the mine in his absence. The best instrument of this kind at present known, perhaps, is that of Mr. Biram. Three, at least, of these should be kept in every mine; one at the intake (bottom of downcast shaft), one at the return (bottom of upcast), and, especially, one or more in the extreme workings. By the anemometer the *actual quantity* of air passing may be known; and at the same time, by the water gauge, the *absolute force or power* required to move or pass that quantity may be known; so that by these two instruments the amount, power, and probable state of ventilation may be ascertained.

The goaves (old workings) in extensive mines are a principal source of danger. It has been suggested, if the water would permit, that the goaves might be as it were drained of the explosive gas by a bore-hole from the surface, acted on by a steam jet; that gas, being lighter than common air, would thus be drawn through the bore to the outer air.

For a similar purpose, a system of gas drifts along the *rise* of the coal deposit, intersecting its cleanages, banks, and interstices, and taken to the upcast shaft, might be, and in some cases has proved to be, a practical and scientific means for removing the light carburetted hydrogen gas from the coal, without permitting it to descend into the workings.

It was suggested by Mr. Gurney, also, that refuge stalls might be established at small expense, in places familiar to the miners, throughout the workings, to which, upon an explosion, they could at once fly from the fatal effects of the after-damp. At the ingoing end of the ordinary stalls, bays, or cul-de-sac recesses of the workings in a coal pit, boarding must be placed, so as to insulate it from the main air-courses, sufficiently strong to withstand the force of a moderate explosion at the spot; or of a violent one at a distance. In this stopping two openings are cut, one at the highest level, and the other as low as possible, so as to effect self-acting ventilation; by which means the bay will always be filled with good air. They also relieve the stopping from the force of explosion. On the inside two valves are suspended, so as to be always ready, in case of need, to close the openings from within. The upper opening is small, about four to six inches diameter; the under opening is sufficiently large for a man to pass through. In case of explosion, instead of the men running, as they now do, into the main air-courses, and consequently into the after-damp, they may go into these refuge stalls, close the openings, and remain there till the after-damp is removed. Taking into consideration the quantity of air required to support life for a given time, and the ordinary size of the stalls, it is clear that men may remain in them in safety for 24 hours, or longer, when properly constructed. During this period the after-damp ought to be withdrawn from the workings. These stalls are inexpensive, require no attendance, and may be made and left, or removed, at short distances, as the ordinary workings of a coal mine proceed. They should be within a hundred yards of each other, so that

one may be always at hand. A few pitmen only would be there, and have occasion to go into the same refuge. The well known laws of pneumatic disturbances show that, properly constructed, it would practically be sufficient to insulate and preserve the atmosphere of the refuge from danger of interchange with the after-damp for a long time together. In the midst, or *close to*, a violent explosion, the stoppings might be blown down; but not at a short distance. A violent explosion would produce death, by its force, in its immediate neighborhood; but in such case the refuge stalls would under any circumstance be useless. They are intended only as a protection against loss of life from *after-damp*. It has been proposed to place large safety flaps or valves in the stoppings, to guard against the force of explosion, but this seems unnecessary.

It has been stated in evidence, that boys are employed in mines to perform duties, the neglect of which in a single instance might be productive of great loss of life. They are employed, in particular, to attend to the opening and shutting of the doors or traps necessary to regulate the courses of air in every system of ventilation. It has further been stated, that even in the best disciplined pits, where the men are rarely, if ever, guilty of serious acts of neglect or carelessness, it has yet been found impossible to guard against similar negligence on the part of the boys; and accordingly it appears that in various instances fatal accidents have been traced to such negligence in the performance of the duties allotted to them. The Committee, therefore, are of opinion, that no responsible duties, the neglect of which would involve serious risk of life, ought in any mine to be entrusted to boys, or to any other class of inexperienced persons, but solely to persons in whose judgment and discretion full reliance can be placed.

Education is a point insisted on as a precautionary means both among the working colliers and their managers, as also that the qualification of inspectors should be rigidly tested previous to their appointment. In these views the Committee entirely concur. They not only trust to see education more rapidly spreading than heretofore among the working colliers, but schools of mines established, without certificates from which no overman, under-looker, or manager, shall be legally appointed to his office.

The qualification of inspectors for their office is a point of the first importance, and should be efficiently tested before a competent board, analogously with the tests exacted in various professions where the interests of life and health are involved. They should be acquainted generally with natural philosophy (especially pneumatics), chemistry, mechanics, also a competent knowledge of geology and mineralogy; and should also have had practical experience of colliery working.

Almost every witness, however, bore testimony to the total inadequacy of the present system of inspection. The numbers were too small, its powers too limited. Each of the inspectors summoned before the Committee had something like 400 mines in his district, the whole of which he would be unable to go through in less than four years. Many mines they had never visited. The Committee cannot therefore hesitate to recommend that the number of inspectors should be increased. They at present amount to six. That number probably should, at least, be

doubled, and two sub-inspectors to each chief inspector be added. In a letter of Sir H. de la Beche to the Committee, it is indicated, and it appeared also in evidence, that the present salary of an inspector was too small, at least to induce a person really fitted for the office of inspector to remain in his situation.

The Committee, for their own part, feel disposed rather to trust to the appointment of an efficient and vigilant Board; to an increased number of well-qualified inspectors and sub-inspectors, who should practically have the power of enforcing such a rate of current of air through the various parts of the mine as, in their judgment, the safety of the miners required, together with the adoption in each mine of such scientific instruments as both preserved a register of the ventilation, and gave warning of danger; that these powers should extend to the inflicting penalties for the non-possession of such instruments, and non-attention to the precautions recommended, and to stoppage of the mine until the right measures were taken. Such measures, together with the better education of the miners, and the establishment of schools of mines, and the circulation among the colliers of such rules and regulations as are adopted in the pits of Mr. Forster and Mr. Darlington, the Committee consider would go far to diminish, and ultimately almost entirely to prevent, the dreadful explosions to which their attention has been called.

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## *On the Manufacture of Malleable Iron and Railway Axles.* By George Benjamin Thorneycroft, Assoc. Inst. C. E.*

Malleable iron may be divided into two distinct classes—"Red-short" and "Cold-short," the former being generally produced from the rich ores, and the latter from the poorer, or leaner ores.

The pig-iron made from the rich ores (under the cold blast process only) is not so fluid as that from the lean ores; when, however, it has been converted into malleable iron, it is tough and fibrous when cold, but is troublesome and difficult to be worked by the smiths at less than a white heat; this want of ductility has caused it to be denominated "Red-short."

The pig-iron produced from the lean ores possesses, on the contrary, more fluidity, and it is thence well adapted for small castings; but when it is manufactured into malleable iron, although in the hands of the smith it is ductile and is easily worked, even at a dark red heat, it becomes, when cold, weak and unfitted to support sudden shocks, or continued strains, and is hence called "Cold-short."

It is obvious, that to obtain qualities of iron suitable for the various purposes to which it is now applied, a judicious mixture of these two kinds must be made; but even this will not suffice, unless the pig-iron, forming the basis, be of a proper quality. It may be received as an axiom, that good malleable iron can only be made from good dark, and bright gray pig-iron, smelted from iron ore alone, or with a very small admixture of any extraneous substance. Iron made from white pig-iron alone is never ductile, although it may be cold-short, whilst it differs materially from

* From the London Civil Engineer and Architect's Journal, August, 1852.

the red-short iron, made from rich ores; in fact, it possesses no good quality either hot or cold, and may be termed "Rotten-short."

The quality of the fuel used in the smelting furnace and in the subsequent processes is very important, for the produce of the best ores may be rendered utterly worthless by the use of inferior fuel; on the other hand, iron made from rich ores, and having great strength when cold, but which cracks in working at a red heat, if smelted with very pure coal, or charcoal, retains all its strength; whilst it becomes much more ductile than if an inferior quality of fuel had been used. Hence, when a strong ductile iron is required, the best fuel must be employed in its manufacture.

The introduction of hot blast for smelting iron rendered necessary a careful investigation into the comparative use of hot and of cold blast pig-iron in the manufacture of bars; the result of this would appear to indicate that if the same quality of materials be used in both cases, equally good bar iron will be produced; but it is more difficult to convert the hot blast pig-iron into "number one" bars, and the waste is greater, than when cold blast iron is used.

It is certain, that whilst good gray pig-iron can only be produced, by cold blast from the best materials, iron of apparently excellent quality can be produced, by hot blast, from the most sulphurous ore and fuel; indeed, to this alone must be attributed the bad reputation of hot blast iron for certain purposes. Castings for the forge and mill, such as rolls, housings, hammers, anvils, &c., which require great strength, as being subjected to considerable strain, or to sudden concussion, should not be made of hot blast iron. Wherever strength and durability are required, a mixture of qualities of iron is essential, in order to produce metal having a bright gray fracture, slightly mottled, which is the best quality. Any nearer approach to gray renders the casting weaker, as the more highly carbonized cast iron becomes (whether hot blast or cold blast), the softer and weaker it becomes, and it can only have strength imparted to it by a due admixture in re-melting. The mixture is generally the result of the experience of the workmen, as no definite system has been laid down, nor have a sufficient number of experiments been made to establish any certainty on the subject.

The same kind of distinction takes place in the texture as in the character of malleable iron—that is, the red-short quality is most inclined to possess a fibrous texture, and the cold-short to present a crystalline or granular fracture, though these characteristics can be materially modified or altogether changed, by judicious mixture and by re-working, and even fibrous iron can be made very ductile; this quality, however, will become granular, when a number of bars, all of the best quality, are bound together, and subjected, in the process of faggotting, to a sufficient degree of heat to weld them into a homogeneous mass; but if that mass be worked down again with a moderate heat into bars of the same size as those from which it was originally made, the fibrous texture will have been recovered. Such iron, whilst in the granular state, will bear impact better than if it had been made of bars whose texture was originally granular.

Malleable iron becomes granular from two causes: first, in consequence of being made from naturally cold-short pig-iron; and secondly, from a

peculiar manipulation during the process of "puddling." If the iron be made up into balls as soon as the granulated particles will stick together, or as the workmen term it "put together young, before it has got into nature," the texture will be fine, and close grained, and the fracture will present a bright granular appearance; such iron will not, however, bear sudden impact, nor will it become fibrous in texture by working until it is reduced into very small bars, or into plate-iron. All granular iron is much harder when cold, and will endure longer than fibrous iron, although it is not so well adapted for general purposes.

It is easy to give a fibrous fracture to iron, by welding the "pile" or "faggot" at a low heat, so that the interior does not become thoroughly solid; but if a pile be subjected to a sufficient degree of heat to make it perfectly sound, and the iron presents a fibrous fracture throughout, when reduced to 1½ inch square or round bars, the quality must be very good.

It has often been asserted that the peculiar quality of some of the Yorkshire iron ores caused the fine granular texture by which the malleable iron of that country is distinguished; the author has, however, uniformly dissented from this opinion, and in order to test the fact, some pig-iron was converted into bars in Yorkshire, and a portion of the same metal was sent to the Shrubbery Ironworks, Wolverhampton, where it was worked up into bars of the same size; the result of this experiment completely verified the author's opinion, as bars of the finest granular fracture and of the strongest fibrous texture, were produced from the same quality of Yorkshire pig-iron.

Identical results were obtained from Staffordshire pig-iron when subjected to different kinds of manipulation.

Swedish iron often presents, in the same bar, both a fibrous and granular appearance. This arises from the method of manufacture, which is very simple: One end of a long pig of iron is placed in a charcoal refinery, and as much metal is melted off as will make a bloom; but the workman commences working it as soon as it begins to melt, and continues to do so until the quantity required for the bloom is melted off into the fire; and when the mass will adhere together, the bloom is brought out and hammered into a bar. It must be evident that by such a process the first portion will have been subjected to a much greater amount of manipulation than the latter, and thus two qualities of iron, or degrees of malleability, are produced in the same bar.

Independently of the alterations of texture which arise from peculiarities in the process of manufacturing iron, great changes are induced by certain actions upon it when cold. Compression, or impact upon the end of a bar of iron, will alter its texture from a fibrous to a granular character. This is well exemplified by two tools used by forgemen. The first is the "gag," which is a short bar of iron, of about 2 inches diameter, employed for holding up the end of the large helve during the intervals of working; it is subjected to impact endways whenever the lower end is placed on the anvil, and the other receives a vertical blow from the helve falling about an inch upon it. However fibrous may be the quality of iron used for making the "gag," it soon becomes brittle, and literally falls to pieces as if it were made of cast iron.

The second instance is that of the tool employed in puddling, one end

of which is constantly subject to blows from a small hammer, in order to detach the metal which adheres to the other extremity; after being some time in use, it frequently breaks at a slight blow, exhibiting a perfectly granular fracture.

If a bar of fibrous iron be bent down at a short angle, the fibres of one side are compressed, and those of the other side elongated; and after being bent back again, the fracture on the compressed side will exhibit a granular appearance, having evidently lost the fibre and been broken off short.

A bar of iron reduced in the centre and used as the connecting rod of a steam engine, by being subjected to constant vibration, or bending, will soon break at the middle, and the fracture will be perfectly granular, although it may have been originally made of the best quality of iron. The connecting rod for working the large shears in rolling mills, and the rods of deep pumps, when they are so small as to bend or vibrate at each stroke, are further examples of this action.

Iron shafting in mills working horizontally being generally too strong to bend, or to vibrate, apparently retains its fibrous quality, even when twisted asunder by a sudden action; but if it be so deficient in strength as to bend and vibrate whilst at work, it soon loses its fibrous nature and is destroyed.

Railway axles should be made parallel from journal to journal, and of sufficient strength to prevent any vibration in rotating. If this general rule were adopted, there would not be any change in texture, and consequently, a less number of fractures would occur. If it be considered necessary to reduce the substance of the middle of an axle, it would be safer to use good granular iron at first, as it is naturally much stiffer and less liable to bend and vibrate than fibrous iron, and would probably not change its form so soon, or receive injury whilst working under ordinary circumstances. It is, however, the author's opinion that axles should be perfectly rigid, so as not to bend or vibrate, even if that should have to be accomplished by making them somewhat larger in the centre, like the connecting rod of an engine.

Many other causes of change could be adduced, but enough has been stated to prove that the compression of iron, when cold, is certain to change fibrous into granular iron, and that vibration or bending, even to a slight extent, if continued for any length of time, has the effect of compressing all the particles consecutively.

A series of experiments was carefully made for the purpose of ascertaining, practically, the best form for railway axles, so as to obtain the greatest strength with a given weight of material. From these experiments it would appear that the forms generally adopted are very erroneous, especially in reducing the substance of the middle of the axles, and in turning rectangular shoulders near to the journals; and they proved, that by simply moving the face of the wheel back from the neck of the journal, the strength to resist impact was increased in the ratio of 100 to 30; that the relative strengths to resist impact where there is no shoulder, and where there is one, is in the ratio of 155 to 55; that the strength of a parallel axle compared with one which has been reduced in the middle, is in the proportion of 5 inches to 1¼ inch. Again, it is well known that

the strength of round bars to resist transverse strain is as the cubes of their diameters, which would give the parallel axle an advantage over the reduced axle in the proportion of 83·74 to 58·18; and as the same law obtains in reference to torsion, if the velocity is the same, the strength to resist torsion will be in a like proportion.

Mr. Thorneycroft said, that though many discussions had taken place, at different times, on the subject of the crystallization or granulation of axle bars, no decision had yet been arrived at on the subject. He was prepared to concur with Mr. Stephenson in the opinion that if the iron was fibrous when worked into an axle, no subsequent jarring motion would alter its character. The granulation of iron might arise from various causes, but nothing so surely affected it as when a bar of iron was gradually bent, so that the fibres on the inner side would be compressed, whilst those on the outer side were extended; and as this process was continued, so the granulation progressed. He did not think that nicking the iron would materially influence the appearance of its fracture, nor would a blow, which merely caused a jar, destroy the fibrous character of the iron. This was well exemplified by two pieces of iron exhibited, which had been used as liners for a tilt hammer. That portion of each which had been compressed by blows, was granular in its fracture, whilst that which had been subjected to constant vibration remained very fibrous.

With regard to the forms of railway axles, it appeared to him, from the experiments, that the nave of the wheel should not be placed close to, but at some little distance (say ¾ inch) from the neck of the journal; also, that the shoulder behind the wheel should be entirely done away with; and instead of reducing the diameter of the axle in the middle, it would be advisable rather to increase its bulk at that point, like the connecting rod of an engine. He had never heard of a single case in which the texture of a fractured parallel axle had been changed from a fibrous to a granular character, although a certain amount of granulation had been repeatedly observed with axles which had been reduced in the middle, and had then been broken in course of regular working. It appeared in all such cases as if there had been a progressive and alternate action of compression and extension of the outer fibres, from the bending of the axle whilst it was rotating; and that thus the granular fracture had been produced.

*Discussion.*—Mr. Gibson said he did not consider it a fair test of the strength and utility of an axle to subject it to hammering, but that it would be preferable to deduce results only from practice. He had found that those axles which were parallel throughout did not bend in the centre, but at a distance of from 7 inches to 24 inches from the nave of the wheel; whereas, axles which were reduced in diameter in the middle, almost invariably bent in the centre. He thought the shoulder behind the wheel was advantageous when of a curved form, but not when it was square to the body of the axle. The shoulder merely served as a gauge for keying the wheels accurately on to the axle.

Mr. Beattie thought the quality of the iron used in the manufacture of railway axles was so important, that he had always advocated the use of the very best material; and to that precaution might in a great measure be attributed the comparative freedom from broken axles on the South Western Railway. With regard to the form of axles, he preferred those

without shoulders, and which were uniform in section between the wheels, because any vibration produced by sudden or violent blows, from the flanch of the wheels coming in contact with the rails, or passing through points, or crossings, would then be more equally distributed: whereas, if the axle was diminished in the centre, the vibration and strain would terminate there, so that the texture and cohesive quality of the iron would, in time, be completely destroyed. It was certainly very disadvantageous to place the nave of the wheel close to the neck of the journal, and shoulders were injurious both to the strength and durability of the axle, and in fact were, in many instances, the cause of their breaking; if, however, it was thought desirable to have shoulders, as gauges for keying the wheels up, they should certainly never exceed $\frac{1}{16}$-inch in projection.

Mr. Joseph Freeman said, as a proof of the importance of the best material and of good workmanship being united in the manufacture of railway axles, he might mention that there was not an instance of an axle made by the Low Moor Iron Company having ever been broken in work; this must be attributed to these combined causes. Much had been argued as to the particular form of the axle, and so far the Low Moor Iron Company agreed with Mr. Thorneycroft that the parallel axle was the preferable form; but he must contend that good material and sound workmanship were the main points.

Mr. Thorneycroft said that the whole series of experiments he had tried, strongly confirmed his previous opinions. He had lately examined fifteen engines in iron works in Staffordshire, including ten engines in his own works, and had found in all of them that the crank pin was placed in a line with the neck of the journal, thereby receiving the strain in the weakest place, and causing constant accidents; now, if the crank pin had been made $\frac{3}{4}$-inch, or even 1 inch longer beyond the face of the crank, leaving a space between it and the spear rod, the liability of accident would have been much reduced, by the strain being thrown on a part of the pin less liable to commence fracture. If a shoulder was left on an axle, it should be curved, for if it was left square, it would induce fracture at that part. It would appear that there was a constant progressive tendency to fracture wherever opportunity was afforded for commencing. Now, a parallel axle did not afford any spot for the commencement of fracture; on the contrary, the fibres extended unbroken throughout the length of the bar; and, unless from the undue weakness of the axle, a constantly recurring bending action occurred, by which the whole external fibres were compressed *seriâtim* as the axle rotated, there could be no tendency to break it; it was therefore important not to weaken an axle by diminishing the centre of it. In conclusion, though an axle reduced in diameter in the centre, might never have been broken, yet it was much more liable to be bent than a parallel axle, and as bending could not take place without compression, which he had shown completely destroyed the fibres of the iron and subjected the parts to sudden fracture, care should be taken to avoid bending in the least degree.—*Proc. Inst. Civ. Eng.*, *Aug.* 1852.

## *On the Colors of a Jet of Steam.**

190. Professor Forbes some years ago observed, that a jet of steam absorbed the more refrangible portion of white light.† It happened during some experiments, that a blue jet of steam caught my attention, and further experiments soon assured me that it was easy to obtain a jet of almost any color.

191. A blowpipe jet was screwed on a T-piece, and the *opposite* opening of the T-piece was supplied with a stopcock, while the third opening of the T-piece communicated, by means of a tube, with the cock of the boiler. The blowpipe jet had an orifice about $\frac{8}{100}$ths of an inch diameter, and its axis was elevated about 28° above the horizon. The stopcock on the T-piece was furnished with a little contrivance, for preventing the steam that it discharged from interfering with the appearance of the steam discharged by the blowpipe jet; the use of this stopcock was to blow off the water which condensed in the steam passages. A pressure was maintained in the boiler of about 40 lbs. on the inch.

192. On fully opening the cock of the boiler, a jet of steam was obtained which appeared blue in nearly every position in which it could be viewed. Looking end on from below, the steam-jet caused that part of the heavens obscured by it to appear feebly orange-colored—the day was bright, but the sky at this quarter was overcast. On looking through the jet of steam from below upwards, but in a direction inclined about 11° to the axis of the jet—in which position a portion only of the steam-cloud could be viewed by the direct light of the clouds, the remaining portion being sheltered by the side of the window—one part of the jet appeared orange-red, namely, that part which transmitted the direct light of the clouds, while the other portion was blue. The blueness of the jet increased with the above mentioned angle until the angle was perhaps 30°, after which the blueness somewhat diminished, but was far from being extinguished at 90°.

193. By partly closing the cock of the boiler, and so discharging steam from the jet of, perhaps, not a higher presure than 10 lbs. on the inch, I could obtain a jet of steam; which, looking end on from below, was blue. It was rather difficult to obtain this blue jet, and when obtained, it kept alternating with violet. On now viewing this blue jet under an angle, as before (192) of about 20°, it appeared reddish-orange in color; this color was not visible at almost any angle, like the reflected blue (192).

194. Looking end on, and adjusting the pressure, I have occasionally seen for a moment at a time a bright green jet; also, and commonly, a blue purple. In the reflected tints I am not sure that I have seen anything more than orange-red, violet, and blue. The transmitted color appeared in my experiments more intense than the reflected tints. This, perhaps, has its explanation in the fact, that when looking end on, the eye receives light which has shone through a columnar arrangement, whose length is much greater than its diameter,—while the reflected lights could only be seen by looking on the convex surface of the columnar stream of particles.

195. Prof. Forbes, after discovering the red color of a jet of steam by

* From the London, Edinburgh, and Dublin Philos. Mag., Aug., 1852.

† Philosophical Magazine, S. 3, vol. xiv. p. 121.

transmitted light, connected the red color of the clouds with this fact; and the truth of this connexion is beyond dispute. So far, however, as I have been able to go, the colors of the steam-jet are manifestly only instances of ordinary interference, greatly resembling that produced by thin transparent plates; the transmitted ray being always complimentary to the reflected. Thus in (192) the transmitted light is red, as in Prof. Forbes's experiments, but the reflected light is blue. It is therefore to be inferred, that all the colors of the clouds originate in interference, caused by minute drops of water, the size of which determines their color; while the blue jet (192) is, I think, strictly analogous to the blue sky.

7 *Prospect Place, Ball's Pond Road, June* 28, 1852.

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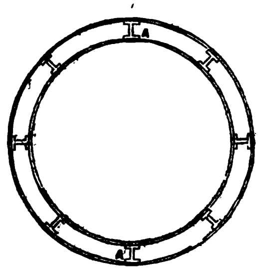
## *Note on the Construction of Sailing Vessels.* By J. P. Joule, Esq., F.R.S.*

Since the now far by-gone times of Peter Pett, the great improver of naval architecture, the general form of ships' rigging has remained unchanged, or, at least, without any material alteration. In our finest vessels we have still the lower, top, and topgallant masts, supported by their respective shrouds and stays. The sails belonging to these masts have still pretty much the same contour; and although attached to the yard throughout the entire length of the head, they are only secured by the corners of the foot, or the clews, to prevent chafing with the stays.

This general form, sanctioned by the experience of centuries, is probably the best which could be employed with wood as the material for the mast; for the capabilities of wood, in resisting a crushing force, are so trifling, that it would be impossible to work a mast of it without lateral support from ropes. With iron, the case is different. The experiments which led to the execution of the Britannia and Conway tubular bridges, have safely demonstrated the great strength of hollow tubes of that metal, and have induced the adoption of the tubular system of metallic construction, in a constantly increasing variety of forms and uses. Of such applications, I am convinced that one of the most important will eventually be in the construction of masts of sufficient strength, to support themselves without the extraneous aid of the usual standing rigging.

Fig. 1.




A conical tube of wrought iron, six feet in diameter at its base, and with plates an inch thick; or, what would be still better, two concentric tubes, each of half-inch plates, and riveted together by means of intervening strips of metal, or transverse stays, would advantageously replace the mainmast and shrouds of a ship of 2000 tons. The weight would be the same, and thus, so far as "top-hamper" is concerned, no disadvantage would result. It is also obvious, that the upper parts of the mast might be constructed to slide within the lower parts, so as to secure the conveniences occasionally derived from lowering the topmasts of an ordinary

* From the London Practical Mechanic's Journal, August, 1852.

ship. The following advantages may be expected to arise from the use of the iron self-supporting mast:

1st. Its strength would be greater than that of its timber competitor, whilst it would, at the same time, be more evenly distributed.

2d. Less resistance would be opposed to the wind, in the ratio of about 2 to 3.

3d. In consequence of the absence of the stays and shrouds, the foot of each sail might be attached to the yard at several places in addition to the clews, and thus a greater effective area of canvass would be obtained, and the tendency to "balloon" would be prevented.

4th. The yards might be braced up to as small an angle with the keel line as the seamen could possibly desire, and hence the sails would be turned to the best advantage when sailing on a wind.

Fig. 1 represents a horizontal section of my proposed duplex concentric tubular mast, taken near its base, the tubes being each of half-inch iron, riveted together by the stays, A.

[Masts of tubular wrought iron have already been used to some extent, but only, so far as we are aware, for large steamers. One or two large iron ships, of Clyde build, have been so fitted, but we are not in possession of their actual details of construction, or their behaviour at sea. Telescopic bowsprits, to work on the principle proposed by Mr. Joule for striking the topmast, have also been patented by Mr. Borrie, but they have not yet come into regular use, although we know that the weight of such constructions in tubular wrought iron is only two-thirds that of the same details in pine. It is, in fact, scarcely possible to overrate the advantages derivable from such a system of construction, for, whilst greater strength is obtainable, with less dead weight, than when timber is used, the telescopic plan furnishes great facilities in the transport of vessels in harbor, as well as in easing their laboring at sea, and enabling them to carry a press of sail much longer. In bowsprits, the jib boom running inside keeps the strain directly on the centre, and obviates the severe twisting strain usually experienced at present in a sea way. Masts and spars also partake more or less of these advantages. Besides, the great losses from the natural decay of timber, and the heavy expense of replacing sprung bowsprits, lower and topsail yards, must be enormously diminished with the employment of tubular iron; and the great improvement in appearance, in comparison with the confessedly clumsy bowsprit, jib boom, and topmasts, is a point by no means to be disregarded.—Ed. P. M. Journal.]

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*Process for giving Various Objects a Pearly Lustre.* By O. Reinsch.*

To produce the iridescence of mother-of-pearl on stone, glass, metal, resin, paper, silk, leather, &c., Reinsch adopts the following process :—2 parts of solution of copal, 2 parts of that of sandarach, and 4 parts of solution of Damara resin (equal parts of resin and absolute alcohol), are mixed with half their volume of oil of bergamot or rosemary. This mixture is to be evaporated to the thickness of castor oil. If this varnish

*From the London Chemical Gazette, June, 1852.

be then drawn by means of a feather or brush, over the surface of some water, it will form a beautifully iridescent pellicle. This film is now to be applied to the objects which are to be rendered iridescent. The vessel in which the water is contained, on which the pellicle has been produced, must therefore be as large as, or larger than, these objects. The water should have about 5 per cent. of pure solution of lime added to it; its temperature should be kept at about 72°. The objects are dried in the air.—*Kunst und Gewerbebl. für Baiern*, 1852, p. 165.

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For the Journal of the Franklin Institute.

## *Remarks upon Maynard's System of Priming for Fire Arms.* By Wm. N. Jeffers, U. S. N.

If we examine the history of inventions, we find that at all periods the class of offensive weapons has exercised the ingenuity of men of all professions, and of this class, portable, or technically *small arms*, furnishes the greatest number. Their use and mode of fabrication being generally well understood, inventive genius has been able to produce the most varied combinations, in general intended to increase the rapidity of firing, and new efforts are being constantly made to adapt these inventions to the requirements of the military service. Hitherto, the principal difficulty has escaped the penetration of inventors; and, while repeating and revolving, breech-loading, and other arms, designed to supersede the musket, have multiplied, until nothing remains new or patentable but the improvement of the mechanical execution of some part of the machinery, the musket itself has suffered from a general neglect.

The progress of invention is generally with rapid strides, when the necessity for its exercise is made apparent, until a point is reached bordering upon absolute perfection; but if we trace back to the fifteenth century the successive improvements which have been made upon the musket, we are astonished that so little has been in reality accomplished.

The invention of cannon having preceded that of portable guns, it was not until the latter part of the 15th century, that a weapon was produced resembling the musket in having a wooden stock, and intended to be supported at the shoulder with the left hand, while fired by a match held in the right. The improvement of this weapon, by the addition of a bent lever, one end of which formed the trigger, the other end carrying a lighted match, which by a movement of the lever could be brought in contact with the priming, occupied another half century, and at this point the Chinese still rest. The next step was the invention of the wheel lock; in which, by the friction of a revolving wheel upon a composition, a shower of sparks was produced, which inflamed the priming: but it was not until 1540 that fire arms entirely superseded the bow and the sling. Sixty years later, the invention of the flint lock gave to the musket its character, and at the end of the seventeenth century, the match lock was finally abandoned.

Two centuries, and those the most prolific in inventions, have elapsed, and the flint lock is still the most common means of igniting the charge in sporting guns; and experienced officers do not hesitate to declare, that in the hands of undisciplined troops, the flint has upon the whole an advantage over the percussion system, as at present arranged. The principal, and, since the invention of the cartridge by Charles XII. of Sweden, almost the only defect in the musket which remains to be overcome, lies in the mode of igniting the charge.

The objections to the flint lock are so generally known and appreciated, that it is unnecessary to repeat them. But the simplicity of the percussion lock; the greater certainty and rapidity with which the charge is ignited; the security from dampness in fogs or rain; the diminution of the charges, and their equality, both of which are conducive to accuracy of firing; the capability of firing a greater number of rounds before cleaning the gun; and various minor but positive advantages which the system possesses over the flint lock, are not sufficient to balance the inconveniences resulting from the difficulty of placing the cap at night, with clumsy fingers, when benumbed with cold, or during the excitement of battle.

To obviate these inconveniences, unwearied efforts have been made to arrange machines for placing caps upon the cone, some attached to the gun, others used by hand, all of which having failed to perform the object, have passed into collections of sporting curiosities. Not satisfied with the cap, which had been generally adopted after long trial had proved it to be with its many disadvantages superior to all other previously known methods, inventors have lately exhumed old and invented new arrangements, until all possible arrangements of reservoirs for pills, tubes, and wafers, would appear to have been tried, and found to be totally unfit for arms in common use, whether placed by hand or the action of machinery. For sporting purposes, therefore, the evil has been suffered to exist; in the military service, one evil has been substituted for another, by enlarging the cap to such a size, weight, and strength, as to be tangible to fingers more accustomed to the mattock than the hair trigger.

This cap, even when made of pure copper, well annealed, that no bits may be blown off to the damage of face and eyes, opposes such a resistance to the blow of the hammer, that it is necessary to form the main spring of the musket of such strength as to require a weight of *eighty-five* pounds to bend it up to the cock notch. Some idea of the force of the blow can be obtained from the fact that the top of the cap is sometimes cut off, and a piece of the copper forced into the vent, which can with difficulty be cleared by digging out the copper with the point of a knife. The effect of this shock on the side of the barrel, in increasing the vibrations and twisting the musket out of the line of aim, aggravated by the difficulty of pulling the trigger, can only be appreciated by those in the habit of handling the arm. For sporting guns, caps are not always made and annealed with sufficient care; hence the necessity for the inconvenient and unsightly snail shell guard, to protect the eyes from flying fragments of copper; and the slight adhesion of the fulminate to the bottom of the cap makes necessary the well known precaution which expe-

rienced sportsmen exercise, of examining each cap before putting it on the cone, to see that the priming has not dropped out. The caps must be carried in a pouch or pocket, from which, if easy of access, the caps are spilled or lost; if securely closed, it is difficult to open, and the operation occupies a considerable time.

The objections to the cap system in the military service, and generally applicable to sporting arms, may then be briefly summed up as follows:

1. The caps are necessarily separated from the gun and the cartridge box, to be carried in a separate pouch, from which they are easily lost, and taken with difficulty.

2. After firing, the motions of half-cocking, handling and placing the cap, and letting down the hammer to secure the cap, occupy, with the best drilled troops, at least one-third of the total time required to re-load; with raw troops, a longer time is required to cap than load.

3. Placing the cap is at all times difficult; but at night, when the sense of touch is the only guide, or with benumbed fingers, it is frequently impossible.

4. A slip from half-cock, or a fall, whether the hammer is down or not, may and often does explode the cap, producing serious accidents.

5. The necessary strength of the springs of the lock seriously affects the accuracy of firing; and when we consider the cost of bringing a soldier in front of an enemy, it must be admitted that no pains ought to be spared to remove, or at least diminish, every cause which militates against the effectiveness of his fire.

If then the cap system is liable to so many and such serious objections, it may be asked, if there is no probability of the discovery of a preferable system? We answer, that such an arrangement already exists; and, were it not that the same force of prejudice and habit still exists, which retained the match lock in service for half a century after the invention of the flint lock, the *Maynard* system of priming would be universally adopted.

In the year 1844, Dr. Edward Maynard, of Washington, an élève of the Military Academy, had his attention directed to this subject. After study and experiment had perfected the idea, he published in 1845 his invention of an entirely new system of priming; in which, retaining from what was already known only the percussion principle, were combined the following leading features, which we mention in what we consider the order of their importance:—simplicity; absolute safety from accidental explosion of the magazine; complete isolation of the separate charges, and yet their union in one piece easily managed by clumsy fingers; exemption from deterioration by exposure to dampness; facility and certainty of fire; increased rapidity of fire; facility of inspection without displacing any of the parts; applicability to existing models of fire arms at a small cost, without requiring any alteration in their form; less expensive than the cap system: all of which advantages it is believed were attained by an arrangement of which the following is a description:

The detonating material of the "Maynard Primer" is in the form of little circular lozenges, each about one-fifth of an inch wide and one-thirtieth of an inch thick. These lozenges are enclosed between two

narrow strips of strong paper, cemented together, and rendered water-proof and incombustible. The strip thus formed is a little less than one-fourth of an inch wide, is very stiff and firm, and contains five of these lozenges (each of which is a *charge*,) in every inch of its length; the charges forming little projections of their own shape, on one side, having considerable and equal spaces between them; the other side of the strip being one flat and even surface.

One of these strips containing fifty or more or less charges, is coiled up and placed in a pear shaped magazine milled into the lock plate just in advance of the hammer, and is fed out by the action of a finger pivoted to the tumbler of the lock, one charge at each time the hammer is raised from half-cock to cock. When the hammer descends, it cuts off and fires the charge fed out upon the vent (or nipple if one is used) of the gun, thus igniting the powder of the cartridge in the barrel; the finger is withdrawn behind the next primer, ready to thrust it forward on re-cocking, while a stationary spring holds the coil.

"These primers are made by a machine capable of making a million per day, at about one-tenth the cost of the percussion caps in military use."

Comparing this arrangement with the existing system, the following advantages claimed by the inventor, are made apparent to the most superficial observer:

1. The soldier applies one coil of priming containing sixty charges (one half more than he has cartridges) to his musket when he has leisure, and has nothing more to do with the priming until these sixty rounds have been fired; hence, in loading, the whole manipulation of "priming" in action is dispensed with; and, according to the testimony of Brevet Major Larkin Smith, with a gain of an increased rapidity of fire of thirty per cent.

2. By the motion of the hammer from "half-cock" to "cock," the gun primes itself with a mathematical precision unattainable by hand, without regard to its position, or to heat or cold, by night or day, in fair weather or foul, whether the soldier be in haste or at ease, attentive or not, skilful or awkward.

3. The primer cannot be fired with the hammer "down" or at "half-cock," nor can it be accidentally separated from the gun, or damaged by being jolted or knocked about with the gun.

4. No jarring, such as is produced by coming to "order arms" upon a stone, or striking the hammer in getting over fences, or catching it among the limbs or twigs of trees, or the dress, or trappings of horses, or rigging of vessels, or any similar disturbance of the lock can fire the primer.

5. The priming requires no tools or appendages, and but a moment's explanation, to be perfectly understood and applied by the soldier.

6. No pieces of metal or other annoying substances are thrown off from the primer.

7. It costs about one-tenth as much as the copper caps now used in the service, occupies less than one-fourth their space, (five hundred primers may be carried in a cylinder occupying in the cartridge box, or elsewhere,

the space of one cartridge,) is of about one-twelfth their weight, and is equally proof against the effect of any climate.

Frequent and prolonged trials in the presence of boards of experienced officers have proved that these advantages exist; but in order that any proposed system, although apparently preferable, should supersede an existing one, it is not merely requisite that it be superior, it is also necessary that it possesses marked advantages, and that these advantages be demonstrated by experiments made under circumstances analogous to those in which troops are placed exposed to all the vicissitudes of service in war. In military affairs, experiment is the only safe guide, and what experiment fails to demonstrate, it is as well to deny, or at least to doubt.

This invention has been submitted to that test, and its superiority over the cap system abundantly proved. Having been for several years subjected to the most rigorous criticism by experienced officers, whose scrutiny had been invited, a hundred real and imaginary objections to the system had to be met and overcome by its author, before the musket, altered from the flint lock in the most clumsy manner to save the expense of half a dollar on each, was placed in the hands of two companies of troops serving in Texas. After some months of exposure, equal in all respects to the circumstances of an active campaign, the most favorable reports were made by the officers commanding the companies, and the report of Major Larkin Smith, one of these officers, winds up by giving as the opinion of himself and other officers who have had practical experience and observation of it for military use, "that it will supersede the cap system."

Toward the close of the Great Exhibition, this invention, which at first, from its great simplicity, and the universal belief that the musket was not susceptible of improvement, was entirely disregarded, assumed a position due to its merits, and riveted the attention of the military of Europe. The defects of the cap system had been felt and acknowledged by them, and their endeavors to obviate these defects had led to a somewhat extended adoption of the needle musket, in which the charge is ignited by friction. Nothing but the advantage of doing away with the cap could have recommended this most objectionable arm to a favorable consideration; it combines all the worst features of the breech loading system, with those peculiar to the union of friction powder with the cartridge.

The Maynard system is now being experimented upon in England, by a board of distinguished officers, the report of which cannot but corroborate that made by our own; and, should not prejudice or interest interfere, we may expect that it will speedily be adopted.

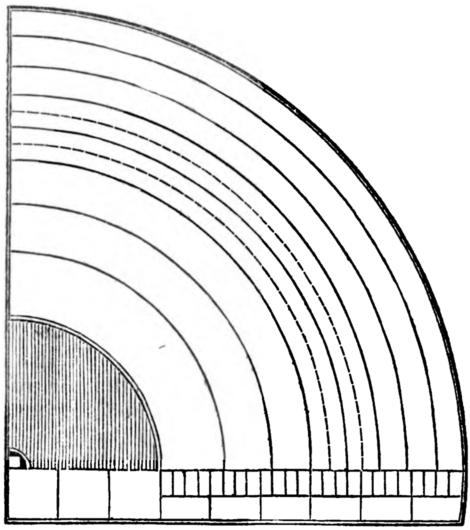
In our own service it is steadily working its way into favor; but the principal obstacle to its general adoption is the want of accurate knowledge of its construction and mode of operation; a knowledge which the writer of this notice, from a sense of its great merits, has endeavored to extend. We leave this subject, trusting that this invention may be examined without prejudice, and with the attention due to its importance; an importance which may be more readily appreciated when we state that at a saving of expense it doubles the efficiency of our arms.

For the Journal of the Franklin Institute.

*The Theory of the Main Spring of a Watch; showing how to select and adjust one that will fit in every respect, without having to try it in the Barrel.* By Alexander Young, Camden, S. C.

Figure 1 is an enlarged sketch of one-fourth part of the spring barrel of a watch. It is laid off into nine equal spaces, eight of which are to show the theory of the action of the spring. The centre space is for the arbor, and is one-third of the diameter. There is a scale of twenty-four equal parts, corresponding to the thickness of the spring, which is estimated by the proportion it bears to the diameter of the barrel: suppose it to be 72 to 1.

Fig. 1.



Two coils of the spring placed in the outside space will then fill it, and if wound on the arbor will fill the inside space, making five coils; if it is attached to the barrel and arbor, as usual, it will cause three revolutions in expanding back to its first position. Nineteen coils will fill the seven outward spaces; and if wound on the arbor, the seven inward spaces with twenty-two coils; having the same difference and revolutions as above, but with greater power, and the action will be more uniform.

Nine and one-sixth coils will fill the four outside spaces, and when wound on the arbor, the four inside spaces increased by five and two-thirds coils. The spring has most action when it fills four spaces, or half the barrel; if it extends to the middle of the fifth space, it will lose one-sixteenth; if to the whole five spaces, one-quarter of a revolution, but will gain in power, and transmit it more uniformly. A scale for any thickness of spring can be applied to the same figure.

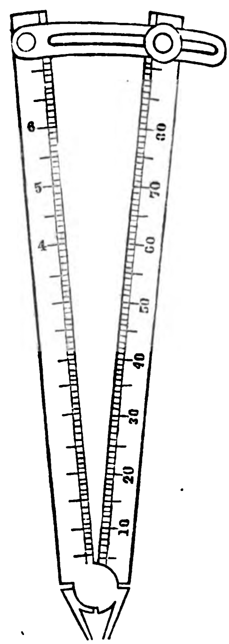
Table of the radius of the circles that divide the spring barrel into nine equal spaces; also, the revolutions taken from them, which are equal to the number of coils that the spring has when wound on the arbor over the number it has when expanded against the rim of the barrel.

The two middle spaces are subdivided; the radius of the two circles and the revolutions made by those divisions are interlined.

| Radius of the Circles. | Revolutions. |
|---|---|
| 36,000 | |
| 33,940 | 2,910 |
| 31,754 | 4,531 |
| 29,392 | 5,392 |
| 28,142 | 5,597 |
| 26,832 | 5,664 |
| 25,455 | 5,597 |
| 24,000 | 5,392 |
| 20,777 | 4,531 |
| 16,970 | 2,910 |
| 12,000 | |

The drawing, fig. 2, shows the form of the callipers and sector combined; the long end is four inches, and is divided from the centre of the joint on both legs, into one hundred equal parts; the divisions opposite to 60, 70, and 80, are marked 4, 5, and 6, corresponding to the numbers for the revolutions of the barrel. In the tables it has a clamp and screw limiting its opening to one inch.

Fig. 2.




The short or calliper end, is four-tenths of an inch, opening to one-tenth, or as ten to the distance across from any two corresponding numbers on each leg of the sector.

The following table shows how many revolutions of the barrel will be produced by the different thickness of the spring. A deduction is made for attachments at the ends, and for the soft part of the spring not unwinding from the arbor, and may amount to one-third of a revolution for a spring of one-eightieth, and to three-quarters, when it is one-sixtieth of the diameter.

| Coils of the spring to the diameter of the barrel. | Revolutions by theory. | Revolutions by experiment. |
|---|---|---|
| 60 | 4·72 | 4·0 |
| 62 | 4·88 | 4.2 |
| 64 | 5·04 | 4·4 |
| 66 | 5.19 | 4·6 |
| 68 | 5.35 | 4·8 |
| 70 | 5·51 | 5·0 |
| 72 | 5·66 | 5·2 |
| 74 | 5·82 | 5·4 |
| 76 | 5·98 | 5·6 |
| 78 | 6·14 | 5·8 |
| 80 | 6·30 | 6·0 |
| 82 | 6·46 | 6·2 |
| 84 | 6·61 | 6·4 |

To select a spring for any number of revolutions, open the sector to the radius of the barrel, at the number on the scale, for the required revolutions, the callipers will then just admit five coils of a spring when of a suitable thickness.

To find the weight of a spring for any size of barrel, take the inside diameter in hundredths of an inch, which is done by opening the sector to its limit, then apply the barrel cap to reach across from side to side, to the same numbers on the counterpart scales, which will be the diameter. The width of the spring is found in the same way. Then enter the table with the diameter of the barrel, take out the three opposite figures, and multiply by the width of the spring, which gives the weight in troy grains for a spring that will fill nine-sixteenths of the barrel.

The table is constructed by taking the area of the arbor from the area of the barrel in hundredths of an inch; nine-sixteenths of the remainder multiplied by 1900, the grains, in a cubic inch of watch spring, gives the numbers for the table.

If the arbor is less than one-third of the barrel, the callipers should fit tightly, and the spring have full weight; if larger, the callipers should fit loosely, and the spring have short weight.

| Table of the diameter of the barrel in hundredths of an inch. | Weight of the spring in grains, troy, for every hundredth of an inch in width. |
|---|---|
| 50 | 1·86 |
| 51 | 1·94 |
| 52 | 2·02 |
| 53 | 2·10 |
| 54 | 2·18 |
| 55 | 2·26 |
| 56 | 2·34 |
| 57 | 2·42 |
| 58 | 2·51 |
| 59 | 2·60 |
| 60 | 2·69 |
| 61 | 2·78 |
| 62 | 2·87 |
| 63 | 2·96 |
| 64 | 3·05 |
| 65 | 3·15 |
| 66 | 3·25 |
| 67 | 3·35 |
| 68 | 3·45 |
| 69 | 3·55 |
| 70 | 3·65 |
| 71 | 3·76 |
| 72 | 3·87 |
| 73 | 3·98 |
| 74 | 4·09 |
| 75 | 4·20 |

The next table is constructed by experiment with a spring twelve-hundredths ($\frac{12}{100}$) of an inch wide, filling five spaces, or five-ninths of a barrel, $\frac{67}{100}$ths of an inch in diameter, of which the thickness of the spring is $\frac{1}{78}$, and weighs 45 grains. The barrel having the chain lapped round it, with a scale for weights, and held fast by the arbor, when the weights are put in the chain, will unroll; the weights required for each revolution are noted, and placed in the table. The spring is then taken out, and its length reduced by breaking off 4½ grains; when replaced, proceed as before, placing the results in the second column of the table. Then remove another 4½ grains, leaving 36 grains of the spring. The weights applied as before, gives the numbers for the third column of the table, which shows the intensity of the spring at the end of each of the five revolutions; when it fills five, four and a half, and four spaces.

| | Troy ounces sustained. | Ounces sustained; four and a half spaces filled. | Ounces sustained; four spaces filled. |
|---|---|---|---|
| | 9 | 8 | 7¼ |
| | 12 | 11 | 10¼ |
| | 14 | 13 | 12¼ |
| | 16 | 15 | 14¼ |
| | 18 | 17 | 16¼ |
| Sum, | 69 | 64 | 60¼ |
| No. of revolutions, | $5\frac{3}{8}$ | $5\frac{5}{8}$ | $5\frac{6}{8}$ |

The sum for each column gives the weight raised to a height equal to the circumference of the barrel. The greatest amount of power is obtained when the five spaces are filled; with four only, there will be more left over the five revolutions, but not sufficient to compensate for the loss of power.

The spring of the best watches fills four and a half spaces, and has a revolution over, to allow for straining up, and still leaving a part free.

The sector, the table, (which can be copied on a card,) and a pair of small scales, with grain weights, are all that is required to select a spring that will have the desired number of revolutions, and the greatest power the capacity of the barrel will admit.

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## *On the Manufacture of Hydrocarbon Coal Gas from Boghead Coal.* By Andrew Fyfe, Esq., M. D., F. R. S. E.*

In a paper published in the *Journal of Gas Lighting* for July, 1850,† I drew the attention of the public to the quality of resin and water gas, and then stated that the gas thus produced had not the high value that was ascribed to it by those who had introduced it, and that, consequently, its introduction as a source of light ought to be abandoned. That I was correct in my conclusions, has been proved by the process having been given up by its most strenuous supporters, and by the patentee himself. Since that time, attention has been drawn to the influence of water over coal gas, and marvellous accounts have been made public of the enormous saving that is to be effected by the introduction of what is now styled "hydrocarbon gas from coal."

In my report on Boghead cannel coal, published in November, 1850, after stating the remarkable qualities of that coal for the purpose of illumination, I concluded by observing:

"It is valuable, not only on account of the large quantity of gas which it affords, and for the high illuminating power of that gas, as indicated by the photometer—it will be found also to be extremely valuable from the large quantity of matter condensable by chlorine which it contains, and which is the principal source of light. Accordingly, were Boghead coal gas mixed with gas from inferior kinds of Parrot coal, and from English caking coal, it would add greatly to their illuminating power; or, which is the same thing, were Boghead gas *diluted* with gas from these inferior coals, while the quantity of gas would be increased, the illuminating power of the Boghead coal gas, as indicated by the photometer, would, most probably, be very little diminished. I conceive, therefore, that the Boghead coal will be of great use to those using inferior kinds of coal in the manufacture of gas, such as the poorer Scotch cannel coals, and especially the English caking coal."

At the time that I made the above remarks, I had in my mind gas, not only from *inferior kinds of coal*, but also from water, by the hydrocarbonizing process, with the view merely of *diluting* the rich Boghead gas, and of enabling us to consume it advantageously; as I conceive that, by the methods in use for burning gas, those rich in matter condensable by chlorine are not so consumed as to make them give the light that they ought to yield, were they properly burned. Since the publication of that report, I have been anxious to put these opinions to the test of experiment; circumstances, however, have prevented me from doing so till within the last few weeks. Having lately had the opportunity of thoroughly investigating

* From the London Mechanics' Magazine, July, 1852.

† Republished in *Mech. Mag.*, vol. LIII., p. 92.

the subject, I shall now enumerate the results. These trials, I may state, were undertaken solely with the view of ascertaining whether the use of water would in any way prove beneficial in the manufacture of coal gas for illuminating purposes; and as I thought that Boghead coal, from its great quantity of volatile matter, and from the high per centage of matter condensable by chlorine in its gas, would be most likely to prove the truth or fallacy of these opinions, I have confined my trials entirely to it.

In considering the hydrocarbon process, as it is now generally styled, two important questions occur:

1. Is there any increase in the *amount of light* obtained from a given weight of coal?

2. Is there any economy in using the water and cannel coal gas, instead of that from Boghead alone?

In the experiments, the results of which I am now to give, the Boghead coal that was used was that with which the gas works at Aberdeen have lately been supplied for the manufacture of their gas.

In my printed report on the value of Boghead cannel, I gave the results of my trials on that which was at that time sent to the works, as yielding 14,800 feet of gas per ton; having 27 per cent. of matter condensable by chlorine, one foot of which gave the light of 7·72 sperm candles burning 140 grains per hour—that is, 9·4 candles of 120 grains; thus making one foot give the light of 1080·8 grains of sperm; the gas per ton of coal was, consequently, equal to 2283·2 lbs. of sperm.

To secure accuracy in the trials with water, the quality of the Boghead coal to be used was first ascertained. For this purpose a quantity of it was broken to pieces, and set aside for the experiments, both on the coal alone, and for the water process. Six trials were made at different times, in the usual way, excepting that the heat was higher than in the trials formerly reported on. Seven pounds of coal were used in all the trials. The following are the results. The durability is that of a cubic foot burnt through a jet one thirty-third of an inch in diameter, and 5-inch flame. The candle is one burning 120 grains per hour.

The average of these trials gives one foot of gas, equal to 11·79 candles of 120 grains, and the gas from a ton of coal equal to 3253·5 lbs. of sperm: a much higher quantity than I got before; but it must be kept in recollection that it was this cargo of coal on which the water trials were made.

| Cubic feet per ton. | Specific gravity. | Condensation by chlorine. | Durability. | Argand 58 holes consuming ft. per h. | Illuminating power 1 ft.=candles | 1 ft.=grs. sperm. | Gas of 1 ton=lbs sperm. |
|---|---|---|---|---|---|---|---|
| | | | m. s. | | | | |
| 15,866 | 595 | 23·75 | 75 50 | 4·00 | 10·57 | 1260·0 | 2856·0 |
| 15,413 | 738 | 26·00 | 85 50 | 5·05 | 11·62 | 1399·2 | 3082·0 |
| 17,680 | 698 | 23·00 | 83 20 | 3·06 | 12·12 | 1454·6 | 3674·0 |
| 16,320 | 652 | 20·00 | 80 00 | 3·77 | 11·93 | 1431·6 | 3337·6 |
| 15,866 | 637 | 20·00 | 79 20 | 4·00 | 11·96 | 1435·5 | 3255·0 |
| 15,413 | 689 | 21·05 | 82 00 | 3·87 | 12·55 | 1506·0 | 3315·9 |
| 16,093 | 650 | 19·75 | 81 03 | 4·12 | 11·79 | 1414·5 | 3253·5 |

In conducting the trials with the Boghead and water together, I had

recourse to an apparatus similar to that erected by Mr. White at Grand Holm, in the neighborhood of Aberdeen, and to those used at Manchester and other places. It consisted of two iron retorts; one for the generation of water gas, the other for the coal gas. Each retort was 2 feet 6 inches long, ⌓-shaped, and 9 inches wide. In each there was a diaphragm, passing from the mouth to within 3 inches of the other extremity, dividing it into an upper and under compartment, shut off from each other, excepting at the back end. Both compartments of the water retort were filled with charcoal, and a tube from a tank conveyed water into its upper compartment, by which the water was made to pass first through the charcoal in it, and then in the lower one, from which the gas generated, along with surplus steam not decomposed, passed through the coals into the lower, and then into the upper compartment of the coal retort. From this it proceeded to the hydraulic main, the condenser, and purifier, to the gasholder, in the usual way. In all the trials two gasholders were used; these were exactly of the same dimensions, were nicely equipoised, and accurately graduated. The whole of the gas thrown off was propelled into them uniformly in the same ratio during the whole of the performance of the experiment, as was proved by their rising in the same ratio; but, to secure accuracy, the gas in each was tested, and found to be of the same composition. In manufacturing the gas, sometimes the usual heat, sometimes a higher, occasionally a lower heat, was resorted to. In ascertaining the illuminating power by the Bunsen photometer, a sperm candle, burning 140 grains per hour, was always employed, and then proportioned to one consuming 120 grains, so as to enable me to compare the results with those of other experimenters. The gas was burned by a 58-hole Winfield Argand; and different trials were made with each gas, to find out the most profitable consumpt. It is unnecessary for me to record all the trials; I leave out those made at first with the view of finding out the proper mode of proceeding, as I found that the process is a very uncertain one, the results varying very much, even when it seems to be conducted under similar circumstances.

The following is a tabular view of the results of the eight trials:

| Cubic feet of gas per ton of coal. | Specific gravity of gas. | Condensation by chlorine. | Durability jet $\frac{1}{33}$, 5 inch flame. | Argand having 58 holes consuming ft. per hour. | Illuminating power per foot= candles 120 grains. | One foot = grains sperm. | Gas per ton =lb. sperm. |
|---|---|---|---|---|---|---|---|
| 39,893 | 434 | 6·05 | 35′ 45″ | 8·0 | 4·61 | 553·2 | 3152·6 |
| 39,893 | 453 | 9·33 | 40 50 | 8·0 | 5·25 | 630·0 | 3590·0 |
| 39,893 | 536 | 11·00 | 43 00 | 9·0 | 5·13 | 615·6 | 3508·0 |
| 38,986 | 646 | 12·00 | 46 40 | 7·2 | 5·46 | 655·2 | 3649·0 |
| 38,986 | 666 | 11·00 | 44 10 | 7·2 | 4·08 | 489·6 | 2726·5 |
| 39,893 | 663 | 12·75 | 46 00 | 7·2 | 4·85 | 582·0 | 3316·8 |
| 39,896 | 600 | 11·33 | 46 30 | 7·5 | 5·02 | 601·2 | 3426·5 |
| 38,986 | 606 | 11·25 | 42 40 | 8·3 | 3 05 | 420·0 | 2339·0 |
| 39,553 | 575 | 11·44 | 43 20 | 7·8 | 4·73 | 568·5 | 3213·5 |

In the two first and the two last of these trials, the production of gas was continued till the desired quantity was obtained. In the others, it

was carried on during the same, or nearly the same length of time, that by previous trials was found to be necessary for carbonizing the same quantity of coal alone. In these instances, the water was more rapidly propelled through the retorts than in the others, especially towards the commencement of the process.

These trials show that the process is very uncertain in its results, even when it is conducted under similar circumstances. The average of all the above mentioned trials is, that from a ton of Boghead coal by the water process, there are obtained in this way 39,553 feet of gas, each foot of which gives the light of 4·73 candles, burning 120 grains per hour; that is, 561·5 grains of sperm, making the gas from a ton of coal give the light of 3213·5 lbs. of sperm.

These results may be considered as what the hydrocarbon process will yield; indeed, they nearly correspond with those given by Dr. Frankland and Mr. Clegg; for, though the quantity of gas is inferior, yet the illuminating power of each foot is superior, and thus the pounds of sperm per ton of coal are nearly the same.

Dr. Frankland, in his Report, (*Journal of Gas-Lighting*, January, 1852,) states that from Boghead cannel he obtained 13,240 feet of gas per ton, the illuminating power of which per foot was 10·52 candles of 120 grains; consequently, each foot was equal to 1262·4 grains, and the gas of the ton was equal to 2387·7 lbs. of sperm. In my trials the average was 3213·5 lbs. per ton; therefore, 34 per cent. beyond his. From Boghead and water Dr. Frankland got 51,720 feet per ton, the illuminating power of which was equal to four candles per foot; and the total quantity was, therefore, equal to 3546·5 lbs. The average of my trials was 3213·54 lbs.

Mr. Clegg, in his Report, published after most of the foregoing trials were made, has given very nearly the same results. He obtained 52,000 feet of gas from a ton of Boghead coal by the action of water, each foot of which was equal to four candles—that is, to 480 grains of sperm; the total quantity was, therefore, equal to 3515·7 lbs. We may, therefore, consider the results of my trials as correct; and thus confirming to a certain extent, those of Dr. Frankland and Mr. Clegg; viz., that from a ton of Boghead coal, by the action of water, a quantity of gas can be obtained which, when properly consumed, will give the light of about from 3200 lbs. to 3400 lbs. of sperm. They differ, however, from them in two very important points; my gas, by the water process, though giving about the same light, was not nearly so great in quantity; it was about 24 per cent. less. Again: in Dr. Frankland's trials, the quantity of gas from Boghead coal amounted only to 13,240, and the pound of sperm to 2387·7 per ton of coal. The increase in quantity of light, by the water process, was, therefore, 47 per cent. In my trials, though the amount of sperm per ton was in some a little more, yet *the average of all the trials gave a little less by the water process than by Boghead alone.* I think that this may be satisfactorily accounted for by the low results obtained by Dr. Frankland from the Boghead coal. I have never had a smaller quantity than 14,200 feet per ton, with one exception, in which case it was only 13,370 feet. Of twelve trials, the quantity varied from 14,200 to 17,680 feet. This may be owing to the low heat at which the gas was driven

off by Dr. Frankland, and which he states is the best, both for the coals alone and for the production of gas by the water process. On the contrary, I have found the best results are got from Boghead coal by using a heat higher than usual. The best result I ever had was that in which the heat was *very high.* In that case I got 17,680 feet; and, what is remarkable, the illuminating power of the gas was also higher; it was equal per foot to 12·12 candles of 120 grains; that is, equal to 2676 lbs. of sperm per ton of coal—a quantity *beyond that got by Dr. Frankland by the water process.*

The above remarks apply solely to trials with Boghead coal, so as to obtain from it a large quantity of gas, the illuminating power of which will be about 4 or 4·5 candles per foot; and, in my opinion, they are sufficient to warrant the conclusion, that though there is an increase in the quantity of gas per ton of coal by the water process, which no one ever doubted, yet that *there is no increase in light from the gas of a ton of coal compared with that obtained in those instances in which the carbonizing of the coal alone is properly conducted.*

Admitting the accuracy of the conclusion to which I have come, and which, in my opinion, the results of my trials warrant, I have next to consider whether there may not be a gain by obtaining a much larger quantity of gas, even though it is of inferior illuminating power.

The results of the trials which I am now to give, were conducted on a smaller quantity of coal, in the same apparatus. The heat of the water retort was kept high, to enable me to pass through it the requisite quantity of water, which, as has *been recommended*, was propelled as rapidly as could be done, towards the commencement of the process. The following are the results of five trials:—

| Cubic feet of gas per ton of coal. | Specific gravity of gas. | Condensation by chlorine. | Durability jet $\frac{1}{33}$, flame 5 inch. | Argand feet per hour. | Illuminating power per foot = candle 120 grains. | One foot = grains sperm. | Gas per ton = lbs. sperm. |
|---|---|---|---|---|---|---|---|
| | | | m. s. | | | | |
| 52,133 | 466 | 5·75 | 35 20 | 8·0 | 2·01 | 252· | 1876· 8 |
| 52,359 | 466 | 6· 5 | 35 30 | 9·0 | 1·91 | 229·6 | 1717· 4 |
| 52,352 | 460 | 6· 0 | 33 50 | 9·0 | 2·06 | 240·8 | 1801·14 |
| 51,680 | 460 | 5·25 | 35 00 | 9·0 | 2·11 | 253·4 | 1870·96 |
| 51,680 | 460 | 5· 5 | 34 10 | 9·0 | 1·81 | 217· | 1602· |
| 52,042 | 462 | 5·08 | 34 40 | 8·8 | 1·99 | 238·56 | 1773·06 |

These trials prove satisfactorily that there is, by this mode of operating, not only no gain, but actually a loss of light *to a very great extent.* From a ton of Boghead coal alone I got gas, the light of which was equal to 3253·5 lbs. of sperm. By this process, though the quantity of gas was great, yet the light of that gas per ton did not exceed 1773·6 lbs. of sperm, showing a loss of 1479·8 lbs. of sperm on the whole quantity—that is, 46 per cent.

Dr. Frankland states that he got 51,720 feet of 4 candle gas from a ton of coal, by the hydrocarbon process; making the pound of sperm per ton

equal to 3546·5. The gas of a ton of Boghead alone was in his experiments equal to 2387·7 lbs. of sperm, there being, therefore, according to him, an increase in the amount of light of 1158·8 lbs. of sperm—that is, of 48 per cent. In my trials, instead of an increase, there was a loss of 1772·3 lbs. of sperm on the whole quantity—that is, of 46 per cent.

How are we to reconcile these discordant results? I have already stated that, while Dr. Frankland got gas from Boghead alone equal to 2387·7 lbs. of sperm, I got gas equal to 3253·4 lbs. But Dr. Frankland's gas, when 51,720 feet per ton were obtained, was equal to 3546·5 lbs. of sperm; which, though an increase of 48 per cent. on the Boghead gas by his own trials, is only 9 per cent over the Boghead gas by mine. Why I have always had a loss instead of a gain, I cannot conceive. The only difference in the modes we have followed, in ascertaining the quality of the gases which we produced, is, that he received into his gasholder only a *part* of the gas as it was evolved from the coal, and of which gas only he tried the illuminating power; while I received the *whole* of the gas into my gasholders, and tested it. Surely my method is the more correct of the two, and claims more confidence in its results. Be this as it may, I conclude from these trials that, by the further use of water, no benefit is derived; indeed, that while the use of a small quantity of water does little harm in diminishing the amount of light, the use of a large quantity of water, with the view of procuring a large quantity of gas, proves injurious to a considerable extent. In further proof of this I give only one trial. In it the illuminating power per ton of coal was reduced in a very great degree.

| Gas per ton. | Specific gravity. | Condensation by chlorine. | Durability. | Argand feet per hour. | Illuminating power 1 foot=cand. | One foot =grains sperm. | Gas per ton=lb. sperm. |
|---|---|---|---|---|---|---|---|
| | | | m. s. | | | | |
| 75,253 | 640 | 4·125 | 29 10 | 9 | 0·27 | 32·4 | 348·3 |

According to Mr. Clegg, 75,000 feet of gas, of 2·4 candles per foot, were got from a ton of Boghead—that is, equal to 2880 lbs. of sperm per ton. I could only get 345·5 lbs. How to reconcile these very discordant results I know not. I wish much that Mr. Clegg had stated the details of the process by which he succeeded in procuring this large quantity of gas, and how he ascertained the illuminating power. That there must be a great loss in all attempts to obtain a large quantity of gas from Boghead is evident. It is well known that, when this coal is carbonized at a low heat, it yields either a comparatively small quantity of gas, or, if the gas be in larger quantity, it is of low illuminating power. In trials with water, in which, with the view of obtaining a large quantity of gas, the water is propelled through the retort rapidly, to produce, as it is supposed, the full beneficial effect, the heat must be brought very low. Hence, probably, the cause of the loss in the illuminating power when we attempt to increase the quantity of gas.

Though, by the use of water to get a large quantity of gas from Boghead coal, there is no increase in the amount of light from the gas of a ton of coal, yet there may be some beneficial influence exerted when the

water is used, as to yield a much smaller quantity of gas. One trial was made in this way, and the following is the result:

| Gas per ton. | Specific gravity. | Condensation by chlorine. | Durability. | Argand feet per hour. | Illuminating power 1 foot= candle 120 grains. | One foot= grs. sperm. | Gas of 1 ton=lb. sperm. |
|---|---|---|---|---|---|---|---|
| | | | m. s. | | | | |
| 24,932 | 554 | 11·75 | 48 20 | 6·8 | 6·51 | 781·2 | 2782·4 |

In this case, though the increase of gas amounted to 54 per cent., yet there was a loss of light in that obtained from Boghead alone to the extent of about 15 per cent.; still further proving that water not only does not exert any beneficial influence, but that, in most cases, it actually proves injurious, by reducing the total amount of light got from the coal in the usual way of carbonizing it.

The remark made regarding the uncertainty of the process is also still further proved by the above trial. It seems difficult so to regulate it as to obtain always the same results.

From what has now been said, I think I am still further warranted in coming to the general conclusion that, *in no instance is there any gain in the amount of light from Boghead coal gas by the agency of water in the method recommended by the advocates of the "hydrocarbon gas,"* and that, in those cases in which the quantity of gas is increased to a great extent, there is a decided loss by the agency of the water.

(To be continued.)

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*Specification of the Patent granted to* George Gwynne, *of the County of Middlesex, England, for Improvements in the Manufacture of Sugar.* Sealed February 27, Enrolled August 27, 1850.*

The first part of my invention will be found sufficiently detailed in the following description: a suitable oxide of lead, say for example, "litharge," is moistened with water, and is then subjected to a process of grinding until it is reduced to a smooth paste. When this is accomplished, twice its weight of refined sugar is added to it, and the grinding continued until these materials are properly combined. This result may be ascertained by putting a small portion of the mixture into a glass, stirring it up with some water, and after a few minutes upon slowly pouring it away. If the operation is perfect, no oxide of lead in a free state will be found at the bottom of the glass. This combination for distinction sake I shall call saccharate of lead. During the grinding, water is to be added from time to time, for the purpose of keeping the materials in a state of moderate consistency, and the generation by friction of such a degree of heat as will darken the sugar should be avoided. When the lead and sugar have properly combined, the mixture should be allowed to remain for forty-

* From the London Repertory of Patent Inventions, No. 705.

eight hours, when the saccharide of lead will be fit for use. During this latter period it may be well stirred up two or three times.

The application of this agent for the purification of saccharine matters is carried on as follows, but the details may be varied.

Some of the saccharide of lead is to be worked up with water to the consistence of cream, and passed through a fine sieve into the "blow-up" or other clarifying vessel.

The raw sugar with the necessary quantity of water is then to be added and the whole mixed together, when the steam or other heat is to be applied until the necessary temperature is attained, which my experiments lead me to consider is two hundred and twelve degrees of Fahrenheit, although it is possible that on the large scale a lower heat, say one hundred and eighty, may be found sufficient. The solution of sugar is now to be filtered through a bag-filter or other suitable filtering apparatus, and when perfectly transparent ("bright") is to be received into a suitable cistern.

In operating on cane juice, beet root juice, &c., I would advise the saccharide of lead to be substituted for the lime or carbonate of lime at present used. When the necessary quantity of this agent has been added, the juice is to be brought to the boil, and then filtered through a bag-filter or other suitable filtering apparatus.

It is, perhaps, unnecessary for me to observe that the quantity of saccharide of lead to be used will depend upon the quantity of the raw material; a little experience will enable the operator to ascertain the requisite proportion. I recommend that a trial should be made in the first instance at the rate of forty pounds of dry litharge to one ton of raw sugar of fair quality, and this proportion may afterwards be increased or diminished with other quantities of the same sugar to suit the manufacturer. As the impurities are more easily precipitated from cane juice, &c., than from raw sugar, it may be advisable to use a smaller proportion of saccharide of lead than is recommended above when operating on such saccharine matters.

After filtration it is necessary to remove a quantity of lead which has got into solution in the bright liquor or juice. There are several chemical agents, such as sulphuric acid, oxalic acid, hydro-sulphuric acid gas, sulphurous acid gas, acidulated ferro-cyanide of potassium, phosphate of lime, binoxalate of potassa, &c., which will render insoluble the lead. I however give the preference to a certain mixture, which can be made in the following manner:—

Calcined bone, "bone-earth," or "bone-ash," in fine powder, is to be well washed by repeated affusions of boiling water. The bone-earth is then to be made into the consistence of thin paste, and two-thirds of its weight when dry of sulphuric acid, previously diluted with four volumes of water, is to be slowly incorporated with it. These materials are then to be simmered for about 12 hours, frequent stirring being resorted to, and from time to time a little water is to be added as it evaporates away.

At the end of this time as much water is to be added as will reduce the mixture to the consistence of cream, when the whole is to be thrown into a conical linen bag to separate the clear fluid, and the residuum washed till the water ceases to taste acid. The strained fluids obtained as above are

then to be evaporated to about half their bulk, and when cold are to be filtered, and the filtered fluid is to be evaporated to dryness in a glass or other suitable vessel, and the mass resulting therefrom is to be heated to a dull redness for an hour in a platinum basin, and when cold is to be reduced to powder.

This powder is to be boiled with some water in a platinum or other suitable vessel; for two vessels constant stirring being employed, and water added from time to time as it boils away, and then to be filtered, and the residuum to be washed with boiling water till the water ceases to taste acid.

The different fluids obtained from the powder are then to be mixed together and brought to the boil, when a thin "cream of lime" is to be slowly added, stirring well at the same time, and continuing the boiling until a slight opacity appears, when filtration is to take place. The clear fluid solution of phosphate of lime, now obtained, is to be slowly stirred into a weak, say one part of soda and twenty parts water, and boiling solution of carbonate of soda until a very slight acidity is produced.

The white precipitate produced in the soda solution by the phosphate of lime is to be allowed to subside, when the clear fluid is to be drawn off, and evaporated to the point at which it begins to show crystals when quite cold. It is then to be mixed with the white precipitate above mentioned; this mixture, for distinction sake, I shall call phosphate of soda and lime; and, though I consider it the best agent for rendering insoluble the lead contained in the bright liquor or juice, I do not mean to confine myself to its use. I shall now describe the manner in which it may be applied.

I shall suppose the bright liquor or juice to have been received into a copper vessel, with a "steam jacket," and that the temperature of the fluid is about 180 degrees of Fahrenheit. Now mix in gradually as much of the phosphate of soda and lime as will render insoluble the lead.

The liquor or juice is now ready for filtration, but before this operation is performed it will be necessary to determine positively that the whole of the lead has been rendered insoluble.

After it has been ascertained by testing, as is now well understood, that the whole of the lead has been rendered insoluble, the liquor or juice is to be filtered through a bag filter, or other suitable filtering apparatus, for the purpose of removing the insoluble lead. The filtered liquor or juice may now be transferred into the vacuum pan or other suitable evaporating vessel, and at once converted into sugar, or, as a preliminary step to this conversion, the liquor or juice may be filtered through beds of coarse grained charcoal, in the manner now practised in many London refiners'.

Before I conclude the description of this part of my invention, I think it necessary to observe, first, that raw sugar may be used, instead of refined sugar, in the preparation of what I have called the saccharide of lead; secondly, that the saccharide of lead may be made by other processes than the one described by me, as, for example, by boiling together litharge, sugar, and water; thirdly, that the smooth parts mentioned in the early part of this specification, and which for distinction sake, I shall

call lead paste, is a powerful precipitator of the impurities contained in saccharine matters; and fourthly, that, although I do not recommend them, hydrated oxide of lead and oxide of lead itself may be employed for the purification of raw sugar, cane juice, &c.

When the lead paste is employed for precipitating the impurities from saccharine matters, it is to be used in the manner described for the saccharide of lead; but, like this agent, the details may be varied.

The hydrated oxide of lead can be prepared by dropping a weak solution of nitrate of lead (stirring well at the same time) into a weak solution of caustic potassa, leaving the latter very slightly in excess, throwing the precipitate in a filter to drain, and afterwards washing it with cold water, for the purpose of carrying away the nitrate of potassa. After being thus obtained, it may be used for the purification of saccharine matters, in the manner described for the saccharide of lead.

Although oxide of lead has little or no effect on the impurities of raw sugar when used in the manner described for applying the saccharide of lead, still it can be made to act strongly on these foreign bodies; as for example, by mixing together one part of finely powdered litharge, twelve parts of water, and twenty-four parts of raw sugar, and evaporating these materials with constant stirring in a water bath, until they attain the consistency of a very thick syrup, when they should be diluted by water to the density of thirty degrees of Beaume's saccharometer, at the temperature of 180, and then filtered. A good liquor will thus be obtained.

I will now describe the second part of my invention, which consists of a mode or modes of preparing and using the basic acetates of lead, or other combination of lead and acetic acid.

The lead paste acetate of lead (or an equivalent proportion of acetic acid) is to be added, in the proportion of about three parts of dry litharge to one part of acetate of lead; and these materials are to be prepared and used in the manner before described for the preparation and use of the saccharide of lead, although the details may be varied. These proportions give the highest basic acetate (hexacetate) known to chemists, but I think it necessary to observe, first, that a still smaller proportion of acetate of lead than above mentioned may be used; secondly, that the grinding up together of these ingredients is not indispensable, as an analogous result may be produced by introducing separately into the liquor or juice the lead paste and acetate of lead or acetic acid, as for example, by putting into the blow-up or other clarifying vessel containing the raw sugar or juice, some acetate of lead or acetic acid, and afterwards adding lead paste; thirdly, that hydrated oxide of lead may be substituted for the lead paste; and fourthly, that it is not absolutely necessary to prepare either the lead paste or hydrated oxide of lead, as oxide of lead itself may be substituted for these bodies, although not in my opinion with advantage.

I will now describe the third part of my invention, which consists of an improved mode of rendering insoluble the lead contained in the bright liquor or juice when the basic acetates of lead, sub-acetate of lead, for example, have been employed to purify the raw sugar cane, &c.

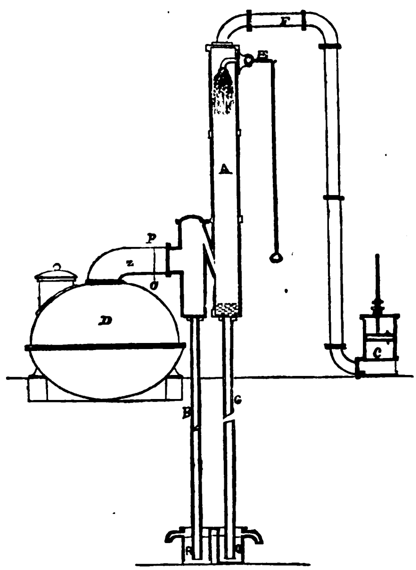
The agent which I prefer for this purpose is prepared in the same manner as the phosphate of soda and lime mentioned in the first part of

my invention, with this difference, that it is made slightly alkaline instead of slightly acid. This mixture, for distinction sake, I shall call alkaline phosphate of soda and lime, and it is to be used as follows, although the details may be varied.

I shall suppose the bright liquor or juice to have been received into a copper vessel with a "steam-jacket," and that the temperature of the fluid is about 180 degrees of Fahrenheit. Now mix in gradually as much of the alkaline phosphate of soda and lime as will render insoluble the lead.

The liquor is juice, and is now ready for filtration, but before this operation is performed it will be necessary to determine positively that the whole of the lead has been rendered insoluble.

After it has been ascertained by testing, as is now well understood, that the whole of the lead has been rendered insoluble, the liquor or juice is to be filtered through a bag filter, or other suitable filtering apparatus, for the purpose of removing the insoluble lead, and afterwards the liquor or juice may be converted into sugar.




Before I conclude the description of this part of my invention, I think it necessary to observe, first, that the phosphate of soda and lime may be used, instead of the alkaline phosphate of soda and lime. Second, that what I have called the white precipitate, which is produced in preparing the above phosphates, may be used in a manner different from that directed by me, as, for example, the clear fluids contained in these phosphates may be added to the bright liquor or juice first, and the white precipitate afterwards. Third, that the above phosphates, instead of being made slightly acid and slightly alkaline, may be made neutral. Fourth, that ammonia or potassa may be substituted for the soda contained in the above three phosphates; and, fifth, that the phosphates of soda, potassa, or ammonia, may be used as substitutes for the phosphate of soda and lime,

the alkaline phosphate of soda and lime, and the neutral phosphate of soda and lime.

I will now describe the fourth part of my invention, which consists of improvements in the vacuum pan, as referred to in the drawing. D, the vacuum pan; B, the receiver; H, a pipe inserted into the bottom of the receiver, B, and thirty-four feet long. It is shown broken in the drawing. This pipe dips into the small box, R, filled with water. A, the condenser; E, the injection cock for the admission of cold water; C, the air pump; F, the pipe of communication between the air pump and condenser; G, a pipe inserted into the bottom of the condenser, A. It is of the same length as the pipe, H, and dips into a similer box, Q, filled with water.

The following description will explain the mode of action:—Any liquor which boils out of the vacuum pan, D, falls into the receiver, B, and from thence down the pipe, H, into the box, R, from whence it flows away into some suitable receiver. The stream from the liquor in the vacuum pan, D, passes into the receiver, B, and from thence into the condenser, A, where it meets the injection water coming through the injection case, E, by which it is condensed, and falls to the bottom of the condenser, A, and passes from thence through the pipe, G, into the vessel, Q, from whence it runs away.

As the whole of the steam which is produced in the vacuum pan, will be condensed by the means above described, it must be obvious that nothing but the air contained in the liquor, or the air coming through leakages in the vacuum pan, can pass through the pipe of communication, F, into the air pump, C.

As there may be sugar houses where there is not a sufficient height to enable these improvements to be carried out in the manner shown in the drawing, the following substitutes may be used:—First, instead of the long pipes, G and H, small pumps may be applied in their places. Second, the exhaust arm, Z, of the vacuum pan, D, may be carried up such a height as will give the necessary elevation for the condenser, A, and the receiver, B. For the purpose of preventing any condensation in the exhaust arm, Z, it might be increased in another pipe between which steam might be admitted.

I am aware that it has been proposed to condense the steam arising from the vacuum pan by injection water passing through a pipe similar to the pipe, G. Now my improvements consist in the combination of the long pipes, and the air pump, or in the combination of the air pump and two small pumps used in the manner described above.

Having thus explained my invention, I wish it to be understood that I do not claim generally the use of basic acetates of lead in the manufacture of sugar; neither do I claim generally the separation of insoluble lead from saccharine matters by filtration through bag or other filters.

But what I claim is,

First, the use and application of saccharide of lead, whether prepared in the manner hereinbefore described, or in any other manner, of lead paste, and of oxide of lead, in the manufacture of sugar, and the use and application of suitable chemical agents for rendering insoluble the lead left in the bright liquor or juice through the use and application of saccharide of lead, whether made in the manner herein described, or in any other manner, of lead paste and oxide of lead. And I also claim the use of bag or

other filters for separating insoluble lead contained in the bright liquor or juice when such lead has been introduced through the use of hydrated oxide of lead.

Secondly, I claim the means herein described of preparing and using basic acetates of lead, or other combinations, lead, and acetic acid, in the manufacture of sugar.

Thirdly, I claim the means herein described of rendering insoluble the lead left in the bright liquor or juice when the basic acetates of lead have been employed to purify the raw sugar cane, juice, &c. And I also claim the separation of insoluble lead produced in the bright liquor or juice in the manner herein described, by filtering the saccharine matters containing such lead through bag or other filters.

Fourthly, I claim the improvements herein described in the combination and working of vacuum pans.

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## *Boiler Explosion.**

London has usually been very free from boiler explosions, although a great proportion of the engines in it are worked with high pressure steam. We regret, therefore, to have to record a very disastrous explosion which occurred on the 2d instant, at a saw mill at Wapping. The circumstances were rather peculiar. The boiler was of the belt shape, cylindrical, with flue through of $\frac{7}{16}$ plates; the ends were strongly stayed, the water was not low, and the pressure was only about 16 lbs. per square inch. The shell was 6 feet diameter, and we should have had no hesitation in working such a boiler to 40 or 50 lbs per square inch. Many boilers about Manchester, of 8 or 9 feet diameter, and the same thickness of plates, are doing so with great safety. In this case the bottom of the shell had become corroded, where it rested on the ridge of brick-work separating the two flues, to such an extent, that in many places not an eighth of an inch of sound metal was left. The boiler had given signs, by excessive leakage for several months, that the bottom was in bad condition, and it had been patched, but no investigation of it by any competent person had taken place. *Had the boiler been tested in its place by hydraulic pressure to* 30 *lbs. on the inch, the accident would never have happened, two lives would have been saved, and the proprietor would have been several thousand pounds the richer.* Such a scene of devastation as it occasioned it has never been our lot to witness before. Similar explosions have taken place at Burnley and Worcester, during the last few days, in both of which we suspect shortness of water will prove to have been the cause.

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## *Self-Acting Plugs for Boats.*†

**To the Editor of the Artizan.**

Sir:—The recent sacrifice of life which attended the loss of the *Amazon* and *Birkenhead* has called forth, among other inventions, that of a self-acting plug for boats.

* From the London Artizan for September, 1852.

† From the London Artizan, September, 1852.

The valve of Lieut. Stevens* has been put in practice, but it is disapproved of by some, in consequence of the centre bolt getting screwed too tight, or, from the swelling of the leather disk, the upper table of the valve cannot be turned round; after trial, they were rejected by the West India Mail Company for this defect.

Another valve (or plug) has been invented by Mr. Lisabe, which consists of a brass box perforated, containing a ball, which, when the boat is immersed, is pressed against an India-rubber seating, and the water is thus kept out of the boat; and when the boat is suspended in the davits, the ball falls by its own gravity, and allows the water to escape.

As this design is very similar to one which I formed some months ago, in connexion with a scheme for lowering ships' boats, I am tempted to commit it to print, because I think it is less complicated in its construc-

Fig. 1.

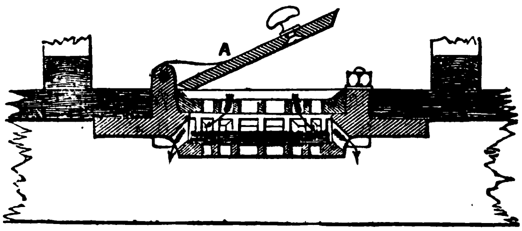
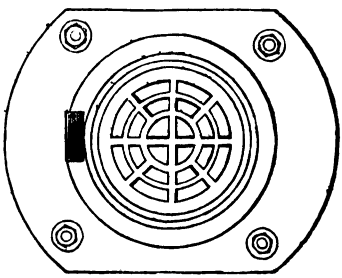



Fig. 2.



tion than that of Mr. Lisabe's. Fig. 1 is a sectional elevation, and fig. 2 a plan, with the upper lid, A, removed. The lower casting forms a shield and face to the India rubber disk, B, and flanch for bolting to the bottom planks of the boat; the upper face is screwed into the lower one, as shown, whilst the lid, A, fits into the top of the upper face or shield.

When the boat is suspended in the davits, the disk, B, will fall on to the lower face, and allow the water to escape through the sides, in the direction of the curved arrows; and when the boat is in the water, the disk will be floated and pressed against the upper face, and the water will thus be effectually kept out; the lid, A, is provided for the purpose of keeping in the water, when it is necessary to clean the boat. India rubber has now been used for several years for marine engine air pump buckets, in an exactly similar manner, with the most perfect success; and there can be no reason why it should not act in the present case.

* See *Artizan*, 1850, p. 259.

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**DECEMBER, 1852.**

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## CIVIL ENGINEERING.

*On the Expansion of Isolated Steam, and the Total Heat of Steam.* By Mr. Charles W. Siemens.*

The object of this paper is to lay before the members the results of certain experiments on steam, purporting, in the first place, to corroborate Regnault's disproval of Watt's law—"that the sum of latent and sensible heat in steam of various pressures is the same;" in the second place, to prove the rate of expansion by heat of isolated steam; and, in the third place, to illustrate the immediate practical results of those experiments in working steam engines expansively.

The amount of heat required to convert one pound of water into steam of different pressures, has occupied the attention of natural philosophers from the earliest periods of the modern steam engine. Dr. Black observed, about a century ago, that a large quantity of heat was absorbed by water in its conversion into steam, (not accompanied by an increase of temperature,) which he termed "the latent heat of steam." His apparatus consisted simply of a metallic vessel containing water, which he exposed to a very regular fire; and from the comparative time which was occupied, first in raising the temperature of the water to the boiling point, and, secondly, in effecting the evaporation, he approximately determined the amount of latent heat. Resuming the experiment, in conjunction with Dr. Irvine, he employed a different apparatus, consisting of a steam generator, and of a surface condenser, or a serpentine tube, surrounded by a large body of cold water. The steam which condensed in the serpentine tube was carefully collected and weighed, and the rise

* From the London Journal of Arts and Sciences, September, 1852.

of temperature of the surrounding water was observed, which, multiplied by its known quantity, represented the total quantity of heat which the steam had yielded.

The quantity of heat requisite to raise the temperature of one pound of water through 1° Fahr., being taken for the unit of heat, Black and Irvine obtained for the total quantity of heat in

| | |
|---|---|
| Steam of atmospheric pressure, the number, | 954 |
| Southern, | 1021 |
| Watt, | 1140 |
| Regnault, | 1145 |
| Dr. Ure, | 1147 |
| Desprer, 1136; but later, | 1152 |
| Brix, | 1152 |
| Guy Lussac and Clement, | 1170 |
| Count Rumford, | 1206 |

All of these eminent experimentalists employed essentially the same apparatus, and the differences between their results prove its great liability to error. Brix, of Berlin, was the first to investigate those errors, and to calculate approximately their effect upon the results obtained.

While such a large amount of labor and talent has been expended, to determine the latent heat in steam of atmospheric pressure, a far more important question seems to have been passed over with neglect, namely, What is the relative amount of heat in steam of various densities? Watt justly perceived the importance of this question, but contented himself with one experiment, upon which he based his law, "that the sum of latent and sensible heat in steam is the same under all pressures." Southern repeated the experiment, and found that steam of greater density contained absolutely more heat than steam of lower pressure, which induced him to adopt the hypothesis, that "the latent heat of steam was the same at all pressures."

Subsequent experiments and general reasoning seemed to be in favor of Watt's law, which enjoyed general confidence until it was attacked, only a few years since, by Regnault, of Paris, who proved, by a series of exceedingly elaborate and carefully conducted experiments, that neither the law of Watt nor that of Southern was correct, but that the truth lay between the two. The apparatus employed by M. Regnault may be said to be a refinement upon those previously employed, and with the advantage of Brix's labors, to determine the amount of errors, he seems to have succeeded in measuring the absolute amount of heat in steam of various pressures with surprising accuracy. The costly and complicated nature of the apparatus employed by M. Regnault, has hitherto prevented other experimentalists from repeating the experiment; and, in the mean time, practical engineers still continue to adhere to Watt's law.

Shortly after the publication of Regnault's experiments by the Cavendish Society, in 1848, the idea occurred to the author of the present paper that their results might be brought to a positive test by a simple apparatus, which he exhibited to the meeting in operation. It consists of an upright cylindrical vessel of tin-plate, surrounded by an outer vessel, filled with charcoal, or other non-conducting material. A steam pipe, with a contracted glass vein or nozzle, enters the upper part of the inner vessel, in a position inclining upwards, in order that the water of priming

from the boiler, and of condensation within the pipe, may return to the former, allowing only a small jet of pure steam to enter the vessel, where it suddenly expands, and communicates its temperature to the bulb of a thermometer, which is inserted through a stuffing box from above. The lower extremity of the inner vessel is connected on the one hand to a mercury gauge, and on the other to a condenser, by means of a stop cock to regulate the pressure. The pressure and temperature of the steam within the boiler being known, and the temperature of the expanded steam observed, it will be seen whether that temperature coincides with the temperature which is due to pressure indicated by the mercury gauge. If it did, then Watt's law would be confirmed; but since the temperature rises higher than is due to the pressure, it follows that the high pressure steam contains an excess of heat, which serves to *super-heat* the expanded steam. All losses of heat from the apparatus would tend to reduce the temperature, and be in favor of Watt's law; but it will be shewn that those losses may be entirely eliminated, and a true quantitative result be obtained. For this purpose, the pressure in the boiler should first be raised to its highest point, and the indicating apparatus be well penetrated by the heat: the fire under the boiler should thereupon be reduced, and observations made simultaneously, and at regular intervals, of the declining pressure within the boiler, and temperature of the expanded steam of constant pressure. The pressures being nearly equal, the fire under the boiler is again increased, and the observations continued until the maximum pressure is once more obtained; and the loss of heat by radiation, &c., may be correctly estimated, by a comparison of the two series of observations.

The second portion of this paper relates to the rate of expansion of isolated steam by heat, that is, steam isolated from the water from which it is generated.

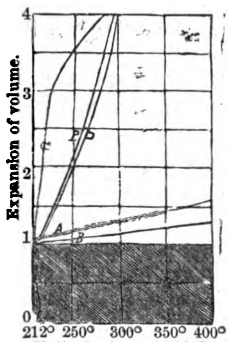
The author has not been able to meet with any direct experiments on this subject, except some at a recent period by Mr. Frost, of America, which, however, do not seem entitled to much confidence. The rate of expansion of air and other permanent gases by heat was first ascertained by Dalton and Guy Lussac simultaneously, who determined that all gases expanded uniformly, and at the same absolute rate, amounting to an increase of bulk equal to $\frac{1}{480}$th part of the total bulk at 32° Fahr. for every degree Fahr., or $\frac{1}{660}$th part of the total bulk at 212°. Dulong and Petit confirmed the law of Dalton and Guy Lussac; but it appears that these philosophers confined their labors to the permanent gases and atmospheric pressure, and merely supposed the general applicability of their discovery.

Being interested in the application of "super-heated" steam, the author tried some direct experiments on its rate of expansion, in the year 1847, which confirmed his view, that vapors expand more rapidly than permanent gases; or, in other words, that the rate of expansion of different gases and vapors is equal, not at the same absolute temperature, but at points equally removed from their point of generation.

The apparatus employed in these experiments consists of a metallic trough, containing oil, which is placed upon a furnace, heated by the flame of gas. One end of the trough is provided with a stuffing box,

through which a glass tube, of about $\frac{1}{18}$th inch diameter, and sealed at one end, may be slipped, and will rest horizontally upon a scale below the surface of the oil. The mouth of the glass tube is connected to an open mercury syphon, with either the one or the other leg filled with mercury, to produce the desired pressure within the horizontal glass tube. A small drop of water and a piston of mercury being introduced into the bottom of the tube, it is placed in the oil bath, and connected to the syphon. The oil bath is then gradually heated, and the temperature observed. As soon as the boiling point of water under the pressure in question is reached, the mercury piston will move rapidly forward, until all the water is converted into steam. The temperature continuing to increase, the piston will continue its course more slowly upon the scale, where its progress is noted from time to time, together with the temperature. The experiment is continued until the temperature reaches about 400°, when the oil begins to boil: the gas flame is then withdrawn, and the bath allowed to cool gradually. The observations of the temperature and the position of the mercury piston are continued until the steam contained behind it is recondensed. A comparison between the two series of observations gives the correct mean of the experiment, by which the effects of the friction of the mercury piston, any possible slight leakage of steam past it, and faults consequent on the slow transmission of heat, are completely neutralized.

The curve, A, on the diagram, has been drawn, expressing the rate of expansion of atmospheric steam according to these experiments. The results of nine separate experiments very nearly coincide (as shown by the dotted lines, which give the extreme variation in the experiments), except at the starting point, where the rate of expansion is so very great, that it is difficult to obtain correct observations: changes in the barometer, moreover, affect the curve in the vicinity of the boiling point. To obviate the effect of these inaccuracies, the unit of volume in laying down the curves from each of the nine experiments was taken, not at the absolute boiling point, but at 250°, where the expansion had already assumed a definite course.



Unit of volume at 212°.

The diagram also shows a straight line, B, expressing the rate of expansion of common air, which at first diverges greatly from the hyperbolic curve of expansion of steam, although the asymptote of the latter seems to run parallel to the former. The author considers it, therefore, highly probable, "that the rate of expansion of all gases may be expressed by one hyperbola, which starts from the condensing point of the gas," and that the apparently uniform rate of expansion of the permanent gases may be accounted for by their great elevation, at the ordinary temperature, above their supposed boiling point, in consequence whereof the true curve approaches so nearly to its asymptote that the difference cannot be detected by experiments.

The general result obtained from the above experiments may be stated

as follows:—That steam generated at 212°, and maintained at a constant pressure of one atmosphere, when heated out of contact with water to

| | | | | |
|---|---|---|---|---|
| 230° | is expanded | 5 | times more than air | would be. |
| 240° | ditto | 4 | ditto | ditto. |
| 260° | ditto | 3 | ditto | ditto. |
| 370° | ditto | 2 | ditto | ditto. |

The author intends to extend the range of his experiments upon gases and vapors under high pressure, and will communicate the further results to the Institution.

The diagram contains another curve, C, showing the results of Mr. Frost's experiments (alluded to before,) which, from the very sudden and irregular rise at the commencement, appears to be affected by some serious source of error.

The two curves of pressure and density, P, and D, show the rate at which saturated steam increases in pressure and in density with the rise of temperature marked at the bottom of the diagram. It will be observed that the pressure increases at a rather greater rate than the density; and it is a remarkable circumstance, that the difference, or the rate at which the pressure increases faster than the density (which is in effect the rate of expansion of saturated steam with the increase of sensible temperature), exactly coincide with the line, B, representing the rate of expansion of atmospheric air.

It has been theoretically demonstrated that a perfect Boulton and Watt condensing engine (abstracting friction and all losses of heat in the furnace and through radiation) would only yield about 7 per cent. of the mechanical force, which would be equivalent to the expanded heat. It may be argued from this, that the steam engine is destined to undergo another great modification in principle; and, in the author's humble opinion, this crisis will be accelerated by inquiries into those properties of gaseous fluids which have hitherto excited but little attention, and especially into the properties of dry steam, or isolated steam.

The present paper will be confined to shewing the effect of the above experiments upon the rate of expansion of steam within the steam cylinder of an engine. It was demonstrated by the first named experiments, that expanded steam is super-heated steam; and, by the second, it is shown what is the expansion of bulk due to an increase of temperature. Supposing the results of the experiments to be correct, the expansion curve as laid down by Pambour, and which is based upon Watt's law, requires a modification due to the excess of temperature in expanding steam, and it will be observed, that this correction in the curve of expansion is in favor of working engines expansively; as a greater average pressure is obtained during expansion than would be the case if the expanded steam were not thus super-heated. Its correctness is corroborated by some actual observations by Mr. Edward A. Cowper in taking diagrams of expansive engines, previous to his acquaintance with the above experiments. It moreover appears, that in Cornwall engineers have been practically acquainted with the fact, that expanded steam is super-heated steam, and more economic in its use than saturated steam; for it is a practice with them to generate the steam at very high pressure, and to expand it down

to the required pressure previous to its reaching the steam cylinder. Another remarkable practical observation is, that a jet of high pressure steam does not scald the naked hand, while a jet of low pressure steam does, although the high pressure steam is the hotter substance. The cooling effect of a jet of high pressure steam is so powerful, that, as the author has been informed, ice has been actually produced in the heat of summer in America, by blowing a powerful jet of steam of 400 lbs. pressure per square inch against a damp cloth. This phenomenon may be explained by the perfectly dry and under saturated state of expanded steam, which with a strong tendency to re-saturate itself, produces a powerful evaporation on moist surfaces with which it comes in contact. The rapid rate of expansion of steam by heat, when still near its boiling point, proves the economy of heating the steam cylinder, either by a steam-jacket, or by the application of fire. It is, however, important to observe, that the specific heat of steam seems to diminish, the more the temperature exceeds the boiling point.

Mr. Crampton inquired whether the charcoal in the casing of the instrument would not get heated by the tube of high pressure steam passing through it during the experiment, and so super-heat the steam in the internal cylinder?

Mr. Siemens explained, that it was not possible for such an effect to take place, as the end of the steam pipe was exceedingly small, and was protected by a thick non-conducting casing. He had also observed several times during the experiments, that whenever any priming took place in the boiler, and a drop of water came out with the steam and fell on the bulb of the internal thermometer, the mercury fell immediately to 212°, or the boiling point of water, and remained steadily there for four or five minutes, until the whole of the priming water was converted into steam, when the mercury again gradually rose to its former temperature. This showed that the increased temperature above 212° in the internal cylinder was entirely due to the extra heat in the expanded high pressure steam, and not to any heat derived from the charcoal casing.

Mr. E. A. Cowper observed, that the only source of heat to raise the temperature of the charcoal casing, was the super-heat in the expanded steam in the interior of the cylinder; as the jet of high pressure steam was so small and well protected, that it could not have any appreciable effect in heating the charcoal: consequently, the charcoal casing could only attain the temperature of the expanded steam that was passing through it, and could not influence the temperature of that steam. In the first experiments tried by Mr. Siemens and himself, the lower end of the cylinder was entirely open to the atmosphere, so as to try the experiment with steam expanded down to the atmospheric pressure; and as the expanded steam was passing out into the atmosphere in a constant stream from the open mouth of the cylinder, it was impossible there that the increased temperature maintained in the cylinder could have been affected by the charcoal casing, and it could only have been due to the extra heat contained in the high pressure steam.

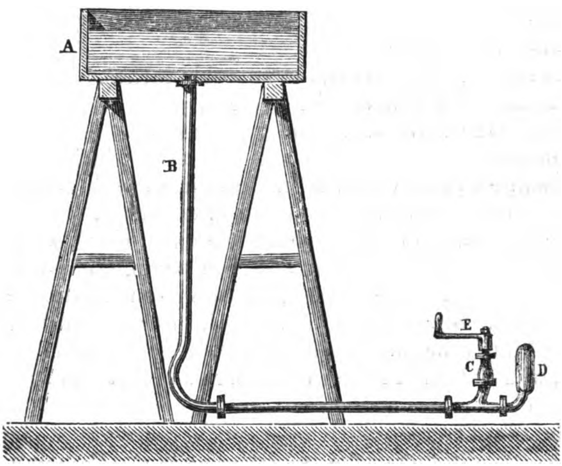
Mr. Siemens said, that as a check on the accuracy of the observations, he had tried them successively in an ascending and a descending series, when any error from the source alluded to would have been made appa-

rent and been doubled in effect; but he could not detect more than one degree difference in the observations.—*Proc. Inst. Mech. Eng., Birmingham, England.*

## *On the Use of Air Vessels in Pumps.**

Some experiments have been made by Messrs. Kirchweger and Prusman, engineers, of Hanover, on the positive effect produced upon the action of pumps by the application of air vessels on the suction pipes. Air vessels have been applied for many years on delivery pipes, but it is only lately that their value has been properly estimated, although it is obvious that it is of as much importance that the pump should be filled with water, as that the delivery should be constant.

Fig. 1.




The apparatus employed by the German engineers is represented in section in fig. 1. A is a reservoir, which represents the source whence the pump draws its water, B is the suction pipe, and C is a valve-chest, containing a ball valve, surmounted by a cock discharging at the side. The plug of the cock is stationary, whilst the shell is moved by the handle, E. D is the air vessel.

Fig. 2.

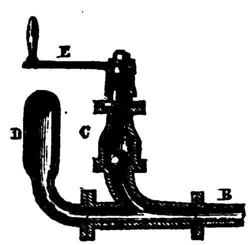



Fig. 2 shows the details of the valve on a larger scale.

It is obvious that, by causing the cock to revolve by means of the handle, E, a certain volume of water will escape each time the passage is opened, the height of water column in the pipe, E, answering to the pressure of the atmosphere in causing the water to fill the pump.

The result of the trials was that, when the air vessel was removed, and the opening stopped, an increased velocity of rotation of the cock gave less water; but with the air vessel the increase of velocity gave more water.

* From the London Artizan, October, 1852.

The trials were made with different speeds and different pressures of water, with the results shown in the following table:—

| Nnmber of turns per minute. | Gallons of water delivered per minute, under a mean pressure of | | | |
|---|---|---|---|---|
| | 17 feet. | 12½ feet. | 8½ feet. | 2¾ feet. |
| With air vessel. | | | | |
| 80 | 12·9 | 12·78 | 8·79 | 2·83 |
| 100 | 15·6 | 15·43 | 11·25 | 4·82 |
| 120 | 17·15 | 16·63 | 12·23 | 5·44 |
| 140 | 18·28 | 16·75 | 12·98 | 5·54 |
| Without air vessel | | | | |
| 80 | 9·45 | 8·62 | 6·902 | 2·36 |
| 100 | 8·03 | 8·08 | 6·05 | 1·98 |
| 120 | 6·55 | 6·54 | 5·42 | 1·88 |
| 140 | 5·42 | 6·29 | 5·17 | 1·51 |

The capacity of the air vessel is 66 cubic inches.

The weight of the ball valve 2·315 lbs.

The area of the valve seat = 11·5 inches.

The smallest diameter of the feed pipe is 1·48 inches.

The quantities delivered at 80 to 100 turns are the mean of four trials; those of 120 and 140 turns are the mean of 3 only.

If these trials are to be taken as the exact result which may be expected under similar circumstances with a pump, it is evident that a large increase of duty may be expected, by adding an air vessel on the suction side of a pump, working at a high speed. For, it will be observed that, whilst at 80 turns the increase is only 20 per cent., at 100 turns it is 133 per cent., at 120 turns 189 per cent., and at 140 turns 266 per cent.

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*Notice on a Disputed Question connected with the Economy of the Steam Engine.* By James Apjohn, M. D., Professor of Chemistry and Mineralogy, T. C. D., M. R. I. A.*

It has been frequently proposed to substitute the vapor of some volatile liquid, such as alcohol or ether, for that of water in the steam engine, under the idea that by so doing fuel would be economized; and the proposal appears *prima facie* plausible, seeing that their boiling points are not only lower than that of water, but that the same is true of their specific heats, and of the latent heats of their vapors. This idea would seem to have struck at different times the minds of different persons, and the Rev. Mr. Cartwright, a gentleman of great mechanical genius, and celebrated for his mechanical inventions, actually devised a most ingenious form of steam engine (see *Phil. Mag.*, vol. i, 1st ser.), in which the piston was to be moved by the vapor of alcohol. Mr. Ainger, in a notice brought by him before the Royal Institution, London, in February, 1830, on the economy of the steam engine, would seem to be the first person who publicly dissented from such views; and he has certainly the merit of having shown the insufficiency of the data generally used by those who, previous to his time, calculated that the substitution of more volatile liquids for water

* From the London Chemical Gazette, October, 1852.

would lead to a considerable saving of fuel. The conclusion, however, at which he arrives, that, leaving the original cost of the liquids out of consideration, water would be as economical a liquid as alcohol or ether, I believe to be quite erroneous; and as the question at issue is one of some practical importance, I shall proceed to state succinctly the method of calculation which I have employed in discussing it, and the precise results at which I have arrived.

As the vapors of different liquids have at their respective boiling points the same elastic force, equal volumes of them will produce equal mechanical effects. In order, therefore, to the solution of the question under consideration, it will only be necessary to calculate the weights of the different liquids, water included, which give equal volumes of vapors, and to determine the quantities of caloric necessary for the conversion of these into vapor.

Now, as the volume of a vapor, like that of any other form of matter, is represented by its weight or mass divided by its specific gravity, if we put

$$\frac{x}{s^1}=\frac{1}{s},$$

$x$ being the weight of any vapor whose specific gravity is $s^1$, and $s$ the specific gravity of the vapor of water, we shall get

$$x=\frac{s^1}{s},$$

that is, the weight of any liquid which at its boiling point gives a volume of vapor equal to that given by a weight of water represented by unity at *its* boiling point, is got by dividing the specific gravity of the vapor by that of steam.

But the specific gravities to be used in this computation are not those usually given in books, each of which is referred to a different unit, viz: air at the same temperature, and under the same pressure as the vapor; but the specific gravities of the vapors at the respective boiling points of the several liquids, compared to the standard unit, viz. air at 60°, and under a pressure of 30. In the following table, the former specific gravities are found in the second, and the others in the third column, the latter being in each case got by multiplying the former by $\frac{518}{458+t}$, $t$ being the boiling point of the liquid which yields the vapor. In column 4 we have the weights which would give equal volumes of vapors, calculated by the expression $x=\frac{s^1}{s}$ already given, the values of $s$ and $s^1$ being taken from column 3:—

| 1. | 2. Specific gravity referred to air at boiling points. | 3. Specific gravity at boiling points referred to air at 60°. | 4. Weights giving equal volumes. |
|---|---|---|---|
| Water. . . . | 0·622 | 0·480 | 1·000 |
| Wood spirit, . . | 1·120 | 0·950 | 1·979 |
| Alcohol, . . . | 1·613 | 1·322 | 2·754 |
| Ether, . . . | 2·586 | 2·397 | 4·993 |

It is now easy to assign the quantities of caloric necessary to produce an equal volume of the vapor of each liquid at their respective boiling points, for these will obviously be represented by the expression

$$mc\{(t—50)+l\},$$

$m$ being for each liquid its number in column 4, $c$ its specific heat, $t$ its boiling point, and $l$ the latent heat of its vapor at the temperature of ebullition. When, with the aid of the annexed table—

| | Boiling points. | Specific heats. | Latent heats. |
|---|---|---|---|
| Water, . . . | 212·0° | 1·00° | 961·8° |
| Wood spirit, . . | 151·7 | 0·67 | 475·2 |
| Alcohol, . . | 172·4 | 0·64 | 374·4 |
| Ether, . . . | 100·4 | 0·50 | 163·8 |

which exhibits the specific and latent heats on which most reliance can be placed, the numerical calculation is made, the following are the results:

| | | |
|---|---|---|
| Water, . . . . . | 1129·0 | 1·000 |
| Wood spirit, . . . . . | 764·8 | 0·676 |
| Alcohol, . . . . . | 875·5 | 0·775 |
| Ether, . . . . . . | 534·7 | 0·473 |

The mere inspection of these numbers is sufficient to show that Mr. Ainger is in error, or that by substituting for water, wood spirit, alchol, or ether, the same moving force will be obtained, and with a great saving of fuel. With wood spirit about two-thirds, with alcohol about three-fourths, and with ether somewhat less than half the caloric required by water will suffice.

To the use, however, of such liquids there are obvious objections. Their cost is considerable compared to that of water; and as they evolve at atmospheric temperatures vapors of a considerable elastic force, they will, from imperfect condensation, resist the descent of the piston, and thus give rise to an appreciable loss of power. But notwithstanding this practical difficulty, which by the way is not, in the cases of alcohol and wood spirit, one of a very formidable nature, the theoretic conclusion is no less certain, that equal volumes of the vapors of different liquids, formed at their respective boiling points under the pressure of a single atmosphere, *do not* require for their production equal quantities of caloric.

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## AMERICAN PATENTS.

*List of American Patents which issued from Oct. 12th, to Nov. 2d, 1852, (inclusive,) with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

20. For *Improved Apparatus for Heating Feed Water of Steam Boilers;* Matthias W. Baldwin, Philadelphia, and David Clark, Schuylkill Haven, Pennsylvania, October 12.

*Claim.*—"What we claim as our invention is, the arrangement of a heater for the feed water of steam boilers, with respect to the chimney, smoke box, and the blast pipes of the escape steam, substantially as herein described; so that the heated smoke and gases from the smoke box, and the exhaust steam from the cylinder, shall pass separately through the heater, in distinct tubes or channels, in such manner that they cannot mix until both have passed the heater, as herein set forth."

21. For an *Improvement in Mill Stones;* Thomas Barnett, Beverly, England, October 12; patented in England, January 8, 1852.

*Claim.*—"I am aware that holes or apertures in upper and under mill stones have been some time in use, and I do not claim simply the making of holes or apertures in mill stones as my invention; but I do claim the making in under mill stones, of holes or apertures, covered with wire gauze cloth, perforated metal plates, or any other substance that will allow part of the meal to pass through, after it is sufficiently ground, in combination with holes or apertures in upper mill stones, containing sweepers, brushes, or rubbers, for the purpose of sweeping, rubbing, or brushing the meal over or through the wire gauze cloth, perforated metal plates, or other substances, without confining myself to the exact detail described in the above specification."

22. For an *Improvement in Gang Ploughs;* Charles Bishop, Norwalk, Ohio, October 12.

*Claim.*—"Having fully described the nature of my invention, what I claim as new is, the manner herein described of constructing the mould boards, and combining them with the blade, in the manner substantially as herein specified."

23. For an *Improvement in Sugar Boiling Apparatus;* William H. Clement, Philadelphia, Pennsylvania, October 12.

*Claim.*—"What I claim as my invention is, 1st, The arrangement and combination of the simmering vessel with the ball cock and the scumming trough, substantially as described in the first part of the foregoing specification; and I claim this arrangement and combination, whether alone, or in further combination with a partial covering of the bottom of the simmering vessel, or the introduction of the steam worm, as there described.

"2d, The agitator, arranged and operating in the manner and for the purposes substantially as described in the second and fourth part of the foregoing specification."

24. For an *Improvement in Scumming Apparatus for Sugar Pans;* William H. Clement, Philadelphia, Pennsylvania, October 12; patented in England, July 23, 1846.

*Claim.*—"In conclusion, I wish it to be understood that I claim as my invention, 1st, the application in the manufacture of sugar, of rotating paddles or leaves, for skimming or taking off the scum and gummous matters from the surface of the liquor."

25. For an *Improvement in Distilling Apparatus;* Charles Delescluze, City of New York, October 12.

"The nature of my invention consists in apparatus for distilling and rectifying spirits, without interruption and without the use of charcoal. I can distil by means of my apparatus, as pure a spirit as that which is imported into this country from Montpelier, France."

*Claim.*—"What I claim as my invention is, 1st, The combination and arrangement of the boilers, *a* and *p*, connected by the pipes, *b* and *l*, with the column, *z*, which enables me to work continually and without interruption, by distilling the contents of one boiler, while the other boiler is being filled, and thus distilling the contents of one boiler immediately after the other, as seen in the description of the work in the former part of this specification.

"2d, The combination and arrangement of the worm, *v*, situated between the two boilers, *a* and *p*, and of the pipes, *u* and *x*, which connect the boilers, *a* and *p*, with the worm, *v*, enabling me to test and ascertain the nature of the liquid contained in the boiler under operation, and to ascertain when the contents of that boiler are distilled."

26. For an *Improvement in Illuminating Gas Apparatus;* Robert Foulis, St. Johns, New Brunswick, October 12.

*Claim.*—"What I claim as my invention is, 1st, the return pipe, in combination with the retort, substantially as set forth.

"2d, I claim, in combination with the said pipe, the false bottom and lining, as described.

"3d, I claim the arrangement of the decomposing chamber, in combination with the return pipe in the vertical retort.

"4th, I claim the employment of the series of decomposing trays under the arrangement in the vertical retort, substantially as described, in combination with the central pipe.

"5th, I claim refrigerating the gas by air, substantially in the manner described."

27. For an *Improvement in Modes of Making India Rubber Bat Cloth;* Charles Goodyear, New Haven, Connecticut, October 12.

*Claim.*—"What I claim as my invention is, passing the bat or fleece of cotton, flax, silk, or other fibrous substance, together with dissolved or softened caoutchouc, gutta percha, or other vulcanizable gum, or the compounds or preparations thereof, between callendering rollers, with an elastic substance interposed between the bat or fleece and one of the rollers, as described, or between the glazed apron and one of the rollers, substantially as described."

28. For an *Improvement in Electro-Magnetic Engines;* John S. Gustin, Trenton, New Jersey, October 12.

"The nature of my invention consists in so arranging the electro-magnets and the parts connected therewith, that their great power of attraction, in close proximity, is continued through the required length of stroke of a reciprocating engine of large or small size."

*Claim.*—"What I claim as my invention is, supporting the principal part of the weight of the armatures of the electro-magnets, mounted upon sliding guides or their equivalents, upon the reciprocating frame, as described, by means of springs or their equivalents, attached to said frame, so as to preserve the balance of weight in the moving parts, substantially as set forth."

29. For an *Improvement in Safety Valves;* Alfred Guthrie, Chicago, Illinois, October 12.

*Claim.*—"What I claim as my invention is, the construction of the cock in the connecting pipe, by which the resistance to the pressure is taken off, and at which the steam will be allowed to escape."

30. For an *Improvement in Double Seaming Machines;* Walter Hamilton, Elmira, New York, October 12.

*Claim.*—"Having fully described the construction and operation of my improved machine, what I claim is, the mandrel, with heads removable at pleasure, in combination with two or more pressure rollers, operating with the same, and with a mallet acting simultaneously with said mandrel and pressure rollers.

"I also claim the adjustable steadying rollers or their equivalents, arranged with reference to the mandrel, and acting substantially in the manner and for the purpose herein set forth."

31. For an *Improvement in Hominy Mills;* James Hughes, Cambridge City, Indiana, October 12.

*Claim.*—"Having fully described the nature of my improved machinery for making hominy and samp, what I claim therein as new are, the combination of the beating cylinder, arranged and constructed as set forth, with the adjustable discharging apertures, by means of which the hulls and eyes are separated from the grain, and the latter is retained within the range of the beaters for a shorter or longer period, according to the grade or size of hominy or samp which is desired."

32. For an *Improvement in Presses for Bundling Flocculent and other Substances;* Daniel Kellogg, Pittsfield, Michigan, October 12.

"My invention consists of a peculiar construction and arrangement of the press box, bed, and platen, whereby the substance being pressed may be single and double, or cross bound, while under pressure."

*Claim.*—"Having thus described my improved press, what I claim as new therein is, the combination of the pressing box, made with openings in its sides, with the platen and bed, turning on swivels, and formed with channels, so arranged as to admit of the passage of the needle and cord through the pressing box, for the purpose of singly and doubly binding fleeces of wool or other substances, while under pressure."

33. For an *Improvement in Gas Regulators;* Walter Kidder, Lowell, Massachusetts, October 12.

*Claim.*—"Having fully described my improved gas regulator, what I claim therein as new is, producing a uniform pressure of gas in the branch pipe which supplies the burners, by means of the inverted cup, the vibratory lever, and the induction valve, arranged and operating within the chamber of the branch pipe, substantially as herein represented and described."

34. For an *Improvement in Gas Regulators;* Walter Kidder, Lowell, Massachusetts, October 12.

*Claim.*—"Having fully described my improved gas economizing regulator, what I claim therein as new is, producing a uniform pressure of gas in the branch pipe which supplies the burners—which may not be varied by the number of burners supplied, nor by the variations of pressure in the main—by means of the counterpoising double inverted cups, the vibratory lever, and the induction valve, so combined and arranged, with reference to the main and the branch pipe, that one of the said inverted cups will be acted upon by the gas in the main, and the other by the gas in the branch pipe, as herein represented and described."

35. For an *Improvement in Gas Regulators;* Walter Kidder, Lowell, Massachusetts, October 12.

*Claim.*—"Having fully described my improved gas economizer, what I claim therein as new is, the producing at all times a proper and uniform pressure of gas in the branch pipe which supplies the burners, which will not be essentially varied by the number of burners supplied, nor by the variations of pressure in the main, by means of the induction valve, the vibratory lever, and the counterpoising inverted cup, combined, and arranged, and operating within the chamber of the main, substantially as herein represented and described."

36. For an *Improvement in Harness Saddle Trees;* Thomas Mardock and William C. Kellar, Cincinnati, Ohio, October 12.

*Claim.*—"Having described the nature of our improvements in harness saddle trees, what we claim therein as new are, the crupper loop, having a shank, which being inserted through the cantle into the pommel, is secured to the latter by the pad hook, in the manner described."

37. For an *Improvement in the Apparatus for Transporting Trains on Inclined Planes of Railroads;* Samuel McElfatrick, Dauphin, Pennsylvania, October 12.

*Claim.*—"I do not claim as my invention dividing the axles of the car, and providing the inner ends of the two parts with independent journals, as this has before been done; neither do I claim the use of an auxiliary track, running down into a pit: but what I do claim as my invention is, making the axles of the safety car in two parts, the inner end of each part being provided with an independent journal, constructed and operated as described, when this is combined with the auxiliary wheels and auxiliary converging track and pit, substantially in the manner and for the purpose specified."

38. For an *Improvement in Grinding Mills;* Oldin Nichols, Lowell, Massachusetts, October 12.

*Claim.*—"What I claim as my invention is, the pointed projections on the front edges of the teeth of the cylinder, when used in combination with the teeth in the concave formed with concavities in their front edges, substantially in the manner and for the purpose herein set forth."

39. For an *Improvement in Expanding Window Sashes;* Mighill Nutting, Portland, Maine, October 12.

*Claim.*—"What I claim as my invention is, the method of varying the pressure of the edges of the expanding sash against the jambs of the window frame, by means of the combination of the adjusting screws and springs with the set screws, or the equivalent thereof, for limiting the extent of the expansion of the sash, substantially as herein set forth."

40. For an *Improvement in Plough Fastening Devices;* James Robb, Lewistown, Pennsylvania, October 12.

*Claim.*—"I do not claim, exclusively of itself, hooking the land side of the mould board; but what I do claim as new and useful is, holding the share to its place by a tightening wedge, having a lip for lap or bite on the share, in conjunction with the headed or lip'd studs, for further securing the same."

41. For an *Improvement in Seed Planters;* James Robb, Lewistown, Pennsylvania, October 12.

*Claim.*—"I do not claim, exclusively of itself, giving to the drill tooth the curvilinear movement specified, as such is old; but what I do claim as my invention is, 1st, Causing the point of the drill tooth, when raised out of the ground, to slope backward, by the

arrangement of the drag bar attachment, the friction pulley, and the curve of the upper part of the drill tooth, to avoid breaking the tooth, as herein described.

"2d, I claim the combined device of endless screw and curved neck and pinion, for producing the result herein specified."

42. For an *Improvement in Burners for Spirit Gas Lamps;* Rufus W. Sargent, Philadelphia, Pennsylvania, October 12.

*Claim.*—"I do not claim the reservoir, burner tubes, or arrangement of the wick. What I claim as my invention is, the combination of the lower chamber or chambers with the upper chamber, for the purpose specified, viz: the lower chamber or chambers, answering the purpose of a heater, volatilize or turn into gas the fluid in the upper chamber, the flame being regulated as above described, and the whole arrangement being substantially as above set forth, without restricting myself by this claim to the precise form of the burner described."

43. For an *Improvement in Packing Water Wheels;* Erasmus Smith, Norwich, New York, October 12.

*Claim.*—"Having described my improved water wheel, what I claim as new therein is, the arrangement of the packing between the edges of the chamber or case and the wheels, in such manner that the packing on the lower portion of the chamber is adjustable from the interior, while the packing round the upper portion of the chamber is set up from the outside of said chamber, substantially as specified, so that the whole of the packing is on the upper side, and none of it under the case, and all capable of being set up or adjusted without the necessity of getting under the case."

44. For an *Improvement in Governors;* John Thompson, Buffalo, New York, October 12.

"The nature of my improvement consists in the use of cords, chains, rods, or their equivalent, when wound upon a spindle or otherwise, as hereinafter described, and combined with or attached to weights or fans, for the purpose of regulating the motion of steam engines, or for regulating the supply of fluids, &c."

*Claim.*—"Having described my invention and improvement in governors, what I claim as new is, the combination of the winding cords or chains, retarders or disks, hub, and spindle, arranged and operating in the manner and for the purpose substantially as herein set forth.

"I also claim operating the governor valve of steam and other engines, by the twisting and untwisting of a flexible cord or chain, or equivalent thereto, attached to revolving retarders, and to the driving pulley placed above the same, and detached from the spindle.

"I likewise claim constructing the clasp with shoulders upon each part, which fit against corresponding shoulders upon its opposite part, and prevent the opening of the clasp, when they are united by the screw, substantially as set forth."

45. For an *Improvement in Glass Buttons;* Arad W. Welton, Cheshire, Connecticut, October 12.

"My improvement consists in impressing upon a concave or underside of the glass centres of buttons, any desired figure, and painting or enamelling such figure with colors uniform or variegated."

*Claim.*—"What I claim as my invention is, the inserting of figures of uniform or variegated colors upon the inside of glass centred buttons, substantially in the mode above described."

46. For an *Improvement in Sewing Machines;* Otis Avery, Honesdale, Pennsylvania, October 19.

"The nature of my invention consists in using two adjustable spring needle bars, moving on the same plane obliquely towards each other from opposite sides of the cloth or other material to be sewn, for regulating the length of the stitch; also, the weight or its equivalent, for drawing through the cloth as fast as it is sewn and released by the needle, one of which is always in the cloth, to prevent it from being drawn entirely through."

*Claim.*—"Having thus fully described my invention, what I claim therein as new is, in combination with the needle bars, the spring holders and adjustable guides, through which the said bars pass, for the purpose of regulating the length of the stitch, substantially as herein described.

"I also claim, in combination with the apparatus for regulating the length of the stitch, the weight or its equivalent, for drawing the cloth forward, as it is alternately released

from the needles, by which means the feed motion is regulated and made dependant on the length of the stitch, substantially as described."

47. For an *Improvement in Spreading Lime and Manure;* Lewis Cooper, Coopersville, Pennsylvania, October 19.

*Claim.*—"What I claim as new and useful is, so constructing the pulverizing and fertilizing apparatus as to effect the several functions of pulverizing and distributing manures of various kinds at will, by so arranging the roller that it can be raised or depressed in the discharging opening of the bottom of the hopper to any required level, so as to discharge a larger or smaller quantity of material, previously brought to the desired degree of fineness in the hopper, and at the same time to act as a valve, to close more or less tightly the bottom of the hopper. The same roller likewise serving as a distributor of seed in sowing broadcast, without any alteration of the machine, substantially as herein set forth."

48. For an *Improvement in Tools for Cutting Pegs out of Boot Soles;* D. D. Allen, Adams, Massachusetts, October 19.

*Claim.*—"Having fully described the nature of my invention, what I claim as new is, 1st, the adjustable float or cutter, connected to a shank by means of the pin or pivot, which turns loosely in the bearing or standard, so as to permit the float to adjust itself to the proper positions to cut the pegs from the heel to the toe of the boot, in the manner herein set forth."

49. For an *Improvement in Grain Separators;* Peter Geiser, Smithsburg, Maryland, October 19.

*Claim.*—"What I claim as my invention is, the method herein described, of regulating the blast of winnowing machines, by means of a flap on the fan case, arranged and adjusted substantially as herein set forth.

"I also claim the reciprocating toothed bars, with the trough, whose bottom is divided into three portions, the lowermost being tight, and acting merely as a conveyor; the middle one acting both as a conveyor and screen, to separate the wheat from the straw, and allow it to pass into the winnower; and the upper or third portion acting as a conveyor for the straw, and a coarse screen, to separate therefrom the heads of unthreshed grain that would not pass through the lower screen, the teeth of the reciprocating bars moving the straw regularly along the trough, and working or shaking the grain and heads so effectually through the screens, that none is left to pass off with the straw when it is discharged from the upper end of the trough."

50. For an *Improvement in Printing Presses;* Lucius T. Guernsey, Montpelier, Vermont, October 19.

*Claim.*—"What I claim as my invention is, the combination of a reciprocating type bed, with an impression cylinder, which has the half-rotary (or reciprocating rotary) movement, and also a movement to and from the type bed, as herein set forth and described."

51. For an *Improvement in Seed Planters;* Edson Hart, New Albany, Indiana, October 19.

*Claim.*—"Having described the nature of my invention, what I claim therein as new are, the rail, with the rod or rods connecting it with the hopper, the said rods occupying traversing collars, with tightening screws, by means of which the relative distance of the axle and the feed shaft are adjusted, to suit different arrangements of gearing, according to the rate of feed desired."

52. For an *Improvement in Apparatus for Elevating and Discharging Bilge Water, &c.;* Nehemiah Hodge, North Adams, Massachusetts, October 19.

"The nature of my invention consists in combining with a series of tanks and tubes, or their equivalents, a ventilating or air tube, which has communication with the tanks for allowing the air to escape from the tanks as the water flows into them, the whole being so placed in the hold of a ship, or other sea-going vessel, for the purpose of elevating and discharging the water from the holds thereof, as that they shall be operated by the fore and aft or rolling motion of the vessel; thus making what I term 'a self-working ship's hydrant.'"

*Claim.*—"I am aware that rocker pumps have been constructed, to be operated by hand power; but in these no adequate provision has been made for receiving and retaining the water as it is raised up; besides, their action is limited to a continuous rapid propelling

power; whilst by my arrangement any varying inclination of the vessel from a horizontal line, however slow, puts the apparatus in operation, and as heretofore constructed, could not, without encumbering the hold of the vessel, be placed therein; I do not therefore lay claim to any such pumps: but what I do claim herein as new is, in combination with a series or system of tanks and tubes, or their equivalents, the ventilating tubes, substantially as described, for the purpose of elevating and discharging water from the holds of vessels; the whole being operated or worked by the motion of the vessel, as set forth."

53. For an *Improvement in Water Wheels;* Ira Jagger, Albany, New York, October 19.

*Claim.*—"I claim the application of an adjustable lip, sliding on the inner surface of the buckets of a turbine wheel, to regulate the openings between the outer edges of the buckets, and thereby the flow of water from the wheel, in manner and form substantially as set forth in the above specification, and thus adapting the lines of the turbine to the head of water and amount of work to be done, however varying."

54. For an *Improvement in making Soda Ash and Carbonates of Soda;* Henry Pemberton, Philadelphia, Pennsylvania, October 19.

*Claim.*—"Having fully described my invention and the means by which the same may be reduced to practice, what I claim therein as new is, 1st, the process of making soda ash by heating the mixture of sulphate of soda and carbonaceous matters, without the use of lime or any other foreign matters, as preparatory to converting the same into other products, substantially as described.

"2d, The process of treating the aqueous solution of the above heated products by carbonic acid, then boiling to dryness, to form a mono-hydrated carbonate of soda, to be treated again in the dry state, by carbonic acid, to form bi-carbonate of soda, as set forth in the specification."

55. For an *Improvement in Bedsteads;* Daniel W. Smead, Peru, Illinois, October 19.

"The nature of my invention consists in the construction of a movable or swinging foot board, that may be raised or lowered, and so as to hold the bed clothes in their proper places."

*Claim.*—"What I claim as my invention is, the swinging foot board, to serve the purpose of a clasp for securing the bed clothes, it being held down by a ratchet and pawl, or otherwise."

56. For a *Sash Stopper and Fastener;* James D. Smith, New Britain, Connecticut, October 19.

*Claim.*—"What I claim as my invention is, the construction of a window or sash stopper, operating by a winding spiral spring; the whole arranged and combined substantially as herein described."

57. For an *Improved Life Preserving Seat;* George P. Tewksbury, Boston, Massachusetts, October 19.

*Claim.*—"I claim the said improved life preserving seat, as made of a combination of the seat, the head or block, the air-tight vessel, and the connecting rods or grasping bars, applied together and used substantially in manner and for the purpose as specified."

58. For *Improved Burglar-Proof Plates for Doors, Safe Walls, Vaults, &c.;* Linus Yale, Jr., Newport, New York, October 19.

*Claim.*—"What I claim as new and of my invention is, a method of making burglar-proof plates, doors, and chests of iron, which, in the process of being cast into the form required for such plates, doors, and chests, surrounds or imbeds malleable iron rods or bars, or their equivalents, arranged substantially as described and shown by the specification and drawings herewith accompanied, or in an equivalent manner.

"I do not claim in said plates, doors, and chests, the casting in of straight rods or bars of malleable iron, or their equivalents, imbedded parallel with each other in only one general direction."

59. For an *Improvement in the Mode of Forming Crucibles and other Articles of Earthen Ware;* John Akrill, Williamsburgh, New York, October 26.

*Claim.*—"I do not limit myself to rotating the mould, as the cutter and burnisher may be rotated; neither do I limit myself to any particular character of earthy and plastic material of which the crucible is to be formed; what I claim is, 1st, the cutters on the stock in combination with the mould, to either or both of which a rotary motion is given, so as to remove the surplus material and shape the crucible, as described and shown."

60. For an *Improvement in Boot Crimps;* Luman Barrett, Gainesville, New York, October 26.

*Claim.*—"I do not claim as my invention the form of the brake, or of the clamps; but what I do claim as my improvement on crimping machines is, arranging a spring lever upon the back of the crimping lever, substantially in the manner and for the purpose herein set forth."

61. For an *Improved Bitt or Drill Stock;* Dexter H. Chamberlain, Boston, Massachusetts, October 26.

*Claim.*—"What I claim as my invention is, the improvement of combining with the bell crank, A, and handle, B, of the bitt stock, the rotary bitt holder or shaft, E, the shaft, K, the pulleys, M, L, and endless band, N, (or two gears as stated,) and the pulleys, G, I, and band, H, or gears, substantially as described, and for the purpose of accelerating the rotary motion of the drill beyond that of the bell crank, when the instrument is used as stated."

62. For an *Improvement in Gilding Daguerreotypes;* Charles L'homodieu, Charleston, South Carolina, October 26.

*Claim.*—"So far as I can ascertain, I am the first to succeed, in a practicable degree, in gilding daguerreotype plates with cyanide solutions; and the first to have gilded those plates at all with cyanide solutions and a single circle of zinc; I therefore claim my mode of gilding daguerreotype plates, substantially as described; that is to say, by the employment of the electric current, and of hot solutions of the cyanides of gold, previously boiled; and I claim the kind of zinc circle or tray designated by the figure 6."

63. For an *Improvement in a Machine for Making Bags of Paper;* Francis Wolle, Bethlehem, Pennsylvania, October 26.

"This invention consists in certain devices, by the combined operation of which, pieces of paper of suitable length are given out from a roll of the required width, cut off from the roll, and otherwise suitably cut to the required shape, folded, their edges pasted and lapped, and formed into complete and perfect bags, which, when dried, will be ready for use."

*Claim.*—"What I claim as my invention is, 1st, giving the proper form to the piece of paper or material from which the bag is to be made by means of the shears, and which cut on the edges of, or on edges attached to the stationary table or inclined plane on which the paper is delivered, and cut out a rectangular piece as shown in figures 6 and 8, from that part which is to form one side of the bag, so as to leave a lapping piece on the part which is to form the other side of the bag, as herein substantially set forth.

"2d, The pasters, in combination substantially as described, with the feeders, which revolve or pass through the paste, and supply them with a proper quantity for pasting each lap.

"3d, The combination of the creasers and the lappers, with the intermittingly moving feed rollers and aprons, in the manner substantially as described, the said creasers and lappers being brought successively into operation on the bags, during the intermissions in the motion of the feed rollers, as set forth."

64. For an *Improvement in Machinery for Combing Wool;* Samuel C. Sister, and George E. Donisthorpe, County of York, England, October 26; patented in England, March 20, 1850.

*Claim.*—"Having set forth our invention, we would have it understood that what we claim is the combination, the endless belt, and the rotary spring bar or bars, (or equivalent therefor,) operating as described, by which we draw the fibres from the gill combs, and carry them forwards to the revolving brush; the whole constructed and made to operate substantially as specified.

"And we also claim the peculiar manner in which the revolving brush, that takes the wool from the nipping apparatus and conveys it to and lays it upon a circular band or belt of upright teeth, is constructed and operated, the same consisting in making the said brush in sections, and combining therewith mechanism, by which not only a range of these sections can be thrown into a straight line with each other, but another and opposite range can be thrown into a curved or bent line, as herein before described, the said mechanism for effecting the movements of the sections of the ranges, being as hereinbefore explained and as represented.

65. For an *Improvement in Watch Keys;* Charles E. Jacot, City of New York, October 26.

*Claim.*—"I claim the key retained in a countersink in the back plate of the watch, by a spring or similar means, as herein set forth."

66. For an *Improvement in Hot Air Furnaces;* Augustus M. Rice, Assignor to himself and Sanford H. Lombard, Boston, Massachusetts, October 26.

*Claim.*—"What I claim as my invention is, the improved mode of making and supporting the grate, viz: by the combination of a single journal, a socket piece, and a crank key shaft, as applied to the furnace and grate, and made to operate substantially as specified.

"I also claim the peculiar combination and arrangement of the horizontal flues, the vertical flues, and the flue space surrounding the chamber of combustion, the whole being essentially as above specified.

67. For an *Improvement in Cooking Stoves;* Hosea H. Huntley, Assignor to David T. Woodrow, Cincinnati, Ohio, October 26.

*Claim.*—"What I claim as new is, giving the arched fire-plate great elevation above the level of the oven top on which its upper edge rests, and giving great capacity thereby to the air chamber formed by the arched fire-plate and oven plates; the under side of the arched fire-plate being furnished with ribs which divide this air chamber into flues transverse the stove, so that the full force of the fire draft is thrown upon the boiler openings and from the top plate of the oven, thereby protecting it from a surcharge of heat, and so that in concert with the flues around the ovens as described, the air must pass from the openings in the side plates to the centre, and thence back to the sides of the stove to the flues leading to the front of the stove, for the purpose of being thrown, very thoroughly heated and in great quantity, around the front oven, and when the damper is opened, around both ovens; it being distinctly understood that I do not claim a fire-plate in itself, nor ribs for guiding air along a fire-plate in themselves, but only my mode of pitching the arch of the fire-plate, and arranging the air chamber, in combination with the flues and damper, as described, so as to produce the aforementioned effect."

68. For an *Improvement in Hot Air Furnaces;* Apollos Richmond, Assignor to A. C. Barstow & Co., Providence, Rhode Island, October 26.

*Claim.*—"What I claim as my invention is, a spiral radiator, constructed substantially as above described, whether the pipes be of a round, square, or oval form in section, or the coils be round, square, or other shape."

69. For an *Improvement in Locks;* F. C. Goffin, City of New York, October 26.

"The nature of my invention consists in the employment or use of a guard, which, with the lever which intercepts the bolt, or prevents it from being withdrawn, rests or bears upon the tumblers; said guard requiring to be freed from the tumblers as well as the lever before the tumblers can be adjusted by the key so as to allow the lever to fall into the recesses in the tumblers, and enable the bolt to be withdrawn."

*Claim.*—"I do not claim the tumblers or the lever, for they are employed in many locks, and have been long known; but what I claim as my invention is, the employment or use of a guard, constructed, arranged and operating in the manner substantially as herein described, whereby the lock is prevented from being picked, by obtaining a pressure upon the bolt, as set forth."

70. For an *Improvement in Constructing Ploughs;* Albert Gardner, for himself, and as Administrator of the Estate of Wm. L. Hunter, deceased, Cincinnati, Ohio, October 26.

*Claim.*—"What I claim as the invention of the aforesaid William L. Hunter and myself, in the construction of the above described plough, is, bolting the standard mould board, landside, and share, to the block or its equivalent, instead of bolting or fastening the parts to each other, as has been practised heretofore, which block may be connected to the beam by a bolt, or otherwise, substantially as described and represented."

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### Re-issue for October, 1852.

1. For an *Improvement in the Seeding Apparatus of Seed Planters;* Lewis Moore, Bart, Pennsylvania; dated July 2, 1850; re-issued October 12, 1852.

*Claim.*—"Having fully described my improvements in seeding machines, I wish it to be understood that I do not claim a reciprocating gauge plate, having apertures parallel

and corresponding with apertures in the bottom of the hopper, as this I am aware is in use in other machines; but what I do claim as my invention is, the employment of a reciprocating gauge plate, when provided with feeding apertures in combination with corresponding apertures in the hopper bottom, which have their sides oblique to the sides of the apertures in the said reciprocating plate, and when combined with a device for giving it a variable reciprocating motion, for the purpose of sowing the seed constantly and uniformly, and varying the amount at pleasure, while the machine is moving, by simply varying the extent of its reciprocating motion, as herein described.

"I also claim the pivoted rod, and the vibratory lever, which is provided with apertures arranged in the arc of a circle whose centre is at the pivoted end of the rod, in combination with the curved or undulating disk and the guage plate, substantially as herein described, for the purpose of imparting to the gauge plate a reciprocating motion, which may be varied at pleasure by the operator, by inserting the rod in one or another of the apertures in the lever, at different distances from its fulcrum."

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DESIGNS FOR OCTOBER, 1852.

1. For a *Design for a Cooking Stove;* Charles B. Tuttle, Amherst, New Hampshire, October 5.

*Claim.*—"What I claim as my invention or production is, the ornamental design for a cooking stove, substantially as represented in the accompanying drawings."

2. For a *Design for a Grate Frame and Summer Piece;* Adam Hampton, New York, October 5.

*Claim.*—"What I claim therein as new is, the combination and arrangement of the ornamental figures herein represented, the whole forming an ornamental design for a grate frame and summer piece."

3. For a *Design for a Table Frame and Legs;* Walter Bryant, Boston, Massachusetts, October 5.

*Claim.*—"What I claim as my production is, the new design, consisting of the scroll, vine, and leaf work, herein above described and represented in the drawings, for the side piece, leg, and cross brace of a table."

4. For a *Design for a Grate Frame;* James L. Jackson, City of New York, October 12.

*Claim.*—"What I claim as new is, the combination and arrangement of the ornamental figures herein represented, the whole forming an ornamental design for a grate frame."

5. For a *Design for a Parlor Stove;* N. S. Vedder, Troy, New York, October 12.

*Claim.*—"What I claim as new is, the ornamental design and configuration of top and front stove plates, such as is herein described and represented in the annexed drawing."

6. For a *Design for a Cooking Stove;* Elihu Smith, Albany, New York, October 19.

*Claim.*—"What I claim as my production is, the combination and arrangement of ornamental figures and forms, represented in the accompanying drawings, forming together an ornamental design for a cooking stove."

7. For a *Design for Forks, Spoons, &c.;* Robert Taylor and Robert D. Laurie, Philadelphia, Pennsylvania, October 19.

*Claim.*—"We do not claim the outline of the spoon, fork, ladle, &c.; but what we do claim is, the design and configuration of the ornaments for spoons, forks, ladles, knives, sugar tongs, &c., above described and set forth in the accompanying drawings."

8. For a *Design for a Cooking Range;* Benjamin Wardwell, Fall River, Massachusetts, and Ephraim R. Barstow, Providence, Rhode Island, October 19.

*Claim.*—"We claim the design consisting of the combination of the wheat sheaf, running vine, and enclosing fillet or bead, as placed on each of the oven or fire place or chamber doors.

"And we also claim the ornamental design on either of the plates, as described."

9. For a *Design for a Cast Iron Cradle;* Pelatiah M. Hutton, Troy, New York, October 26.

*Claim.*—"What I claim as my invention is, the design and configuration of the orna-

ments upon the body and upon the sectional parts, combined as in the drawing hereunto annexed, to form an ornamental iron cradle."

10. For a *Design for a Cooking Stove;* James Wager, Volney Richmond, and Harvey Smith, Troy, New York, October 26.

*Claim.*—"What we claim therein as new is, the above described ornamental design and configuration of the plates as represented."

## NOVEMBER.

1. For an *Improvement in Pile Wires and Pincers for Weaving Pile Fabrics;* Erastus B. Bigelow, Clinton, Massachusetts, November 2.

*Claim.*—"Having pointed out the nature of my invention and its mode of operation, I would remark that I do not wish to confine myself to the precise form of the parts represented; nor do I claim as new constructing them for hand looms; but what I do claim is, making one part of the pile wires which is to be grasped by the pincers, wedged form, or oval shaped, in combination with grooves in the jaws of the pincers to conform thereto, substantially in the manner and for the purpose specified."

2. For an *Improvement in Edge Planes for Shoemakers;* Nicholas Bucher, Weedsport, New Jersey, November 2.

*Claim.*—"What I claim as my invention is, securing the plane iron, or knife, in a sliding tung, passing through a mortise in the body or handle of the plane, substantially as herein set forth, whereby, with great simplicity of construction, I obtain the facility of adjusting the instrument to the thickness of the sole of the boot or shoe, and of employing the draw cat."

3. For an *Improvement in Sewing Machines;* Christopher Hodgkins, Boston, Massachusetts, November 2.

*Claim.*—"What I claim as my invention is as follows: I do not herein intend to claim in the mechanism for feeding the cloth, "a notched bar which has a vertical or up and down motion, for fastening the cloth upon, and relieving it from the notches of said bar, by striking it against a yielding plate, and a lateral motion, or motion forwards and back;" but what I do claim as an improvement therein is, the employment of one or more burr wheels, *g*, applied to the carriage, K, and kept continually against the cloth by a spring, (so as to preserve the cloth from falling away from the spring plate or presser over it,) in combination with a spring brake, *k*, operated as described, the whole being combined and made to operate together, substantially as specified.

"And in combination with the presser, G, and the lower needle, I claim a mechanism by which an increase of thickness of the cloth is made the lower needle to the left, the distance required to bring it into correct position, with respect to the upper needle, so as to prevent the said upper needle from passing into the cloth, before passing into the bow of the thread of the lower needle, as set forth.

"And I claim the combination of the slide rod, $m^2$, the box, $n^1$, screw, S, slotted arm, *v*, shaft, *w*, arm, *x*, connecting rod, $f^1$, slide, $a^1$, stationary plate, $b^1$, and cam plate, $c^1$, as applied to the fulcrum pin, W, of the lever, V, and to the presser, for the purpose of moving the lever, with respect or nearer to the cam, U, for the purpose and in the manner herein described."

4. For an *Improvement in Vibrating Propellers;* Franklin Kellsey, Middletown, Connecticut, November 2.

*Claim.*—"What I claim as my invention is, the combination in a field or row, of a multiplicity of inclined planes, or sculls, secured by gudgeons on one of the sides thereof, in a frame vibrating horizontally, and the graduation of their propelling velocities, by a similar multiplicity of check pins or stops, so adapted to the respective planes or sculls, that, in vibrating the same, they may propel, as nearly as possible, in equal times, and thereby reduce the propelling principle of the tail of a fish, as nearly as may be, to mechanical purposes, substantially as above described, for the propelling of all kinds or classes of vessels, or boats, by the power of steam, or other power, and with or without sails, as occasion may require."

5. For an *Improvement in Gas Metres;* John Laidlaw, City of New York, November 2.

*Claim.*—"What I claim as my invention is, the chamber, B, and syphon, M, in combination, in the manner substantially as described, with the pipes, I, J, or other pipe or

pipes, having an opening or openings, similar to J, at the required level of the liquid in the metre, for the purpose of preserving the level and discharging the surplus liquid from the metre."

6. For an *Improvement in Saw Gummers;* J. D. Otstot, Springfield, Ohio, November 2.

*Claim.*—"Having thus fully described my improved apparatus for gumming saws, what I claim therein as new is, the combination of the frame, shoe, and set screws, in the manner and for the purposes set forth."

7. For *Improved Manufacture of Wire Ferrules;* Wm. T. Richards, New Haven, Connecticut, November 2.

"My improvement consists in manufacturing the wire ferrule, that both ends of it may be smooth, true, and at right angles to its length."

*Claim.*—"I am aware that wire ferrules have been made, when the coil has been cut directly across the wire; I therefore do not claim the manufacture of wire ferrules, as such, as my invention; but what I claim is, the manufacture of ferrules from iron wire, by cutting them from a helical coil, in such a manner that both ends of each ferrule will be perfectly smooth, true, and square across, at right angles to the length, so that no other finishing of the ends will be needed, to render them fit for use, and so that when soldered, they will be the most convenient and durable ferrules which can be made, when manufactured in the manner substantially as described."

8. For an *Improvement in Seed Planters;* Charles Randall, Palmyra, Georgia, November 2.

"My invention consists in a novel and peculiar arrangement of drill, constructed with particular reference for adapting it to the dropping of cotton seed, but it can be used with nearly equal advantage for a variety of other seed."

*Claim.*—"Having thus fully described my invention, what I claim as new is, the two disks, combining a hopper, plough, and carrying wheel, substantially as described, in combination with the segment plates, or their equivalents, by which the discharge of seed is regulated, operating substantially as in the manner and for the purpose herein fully set forth."

9. For an *Improvement in Cooking Stoves;* Manly C. Sadler, Brockport, New York, November 2.

*Claim.*—"What I claim as my invention is, the guard plate for carrying the products of combustion under the oven, that part thereof may pass around and over it to the front, and the rest continue to and up the back flue, substantially as specified, in combination with the recess in the rear of the fire chamber, for extending a portion of the fire near to the oven, and the deflexion plate for dividing the draft and carrying it towards each end of the oven, substantially as and for the purpose specified."

10. For an *Improvement in Seed Planters;* Francis Townsend, Cambria, New York, November 2.

*Claim.*—"In combination with the regular and positive discharge of seed, by means of the ordinary seed distributor of seed drills, I claim the supplemental or occasional discharge of seed, by a supplemental seed distributor, put in and out of action at the discretion of the operator of the machine, substantially as herein set forth."

11. For an *Improvement in Seed Planters;* Constant S. Trevitt, Ellicottsville, New York, November 2.

*Claim.*—"What I claim is, the combination of the perforated register plate, the adjusting screw, and the springs arranged and operating as described."

12. For an *Improvement in Seed Planters;* Henry Vermillion, Rising Sun, Maryland, November 2.

*Claim.*—"Having described my improvement in the distributing apparatus of seed planters, it will be understood that I do not mean to claim the use of a reciprocating gauge plate, having oblique feed openings therein, operating in combination with openings of different obliquity, in the grating plates and bottom of the hopper, for increasing or

diminishing the feed of the seed to be sown, while the machine is in motion, by increasing or diminishing the traverse or sliding movement of the gauge plate; but what I do claim as my invention is, the employment of the pivoted oscillating plate, when made with oblique openings on opposite sides of its centre, reaching to and forming outlets at the circumference of said plate, in combination with segmental or other similar openings above the oblique opening, and a central annular opening in the ring plate, whereby during the oscillation of the pivoted plate, the seed is not only discharged from the outlets of the oblique openings over the circumference of the ring plate, but also through the central annular opening of the ring plate from the centreward ends of the oblique openings."

13. For an *Improvement in Ventilators;* David Wells, Lowell, Massachusetts, November 2.

*Claim.*—"I do not claim a ventilator made of a series of flat plates, arranged in a circle, with openings between them; nor do I claim one made of a series of plates arranged in a circle or around an axis, and with openings between them, and each made to stand tangential or curved (transversely) to the arc of a circle or curved line of the set of plates: but what I do claim as my invention is, a ventilator constructed of a single series of curved or angular plates and openings, and capped, connected with a tube or flue, and having each plate curved or made angular convexly or concavely, out of the general line of their arrangement, around a common axis, as represented in the drawings."

14. For an *Improved Method of Securing Vault and Safe Doors, &c.;* F. C. Goffin, City of New York, November 2.

"The nature of my invention consists in securing or fastening the doors of safes, bank vaults, &c., &c., by means of movable flanches attached to the door, and arranged as will be hereafter described; said flanches forming a continuous bolt all around between the door and its mouth piece, by which means the door is rendered more secure against fire and force, and less liable to get out of order, than by any other mode of construction."

*Claim.*—"Having thus described the nature and operation of my invention, what I claim as new is, securing or fastening the doors of safes, bank vaults, &c., by means of movable flanches, arranged and attached as herein shown and described, by which means a continuous bolt is formed all around between the door and its mouth piece, preventing the admission of air into the safe, which is thereby rendered secure against fire, and the door against force."

15. For an *Improvement in Mode of Counterbalancing Harnesses in Looms;* James Greenhalgh, Waterford, Massachusetts, November 2.

*Claim.*—"I do not claim the mere upright position of the jacks, or the mere counterbalancing of the harness; but what I do claim is, the construction of the long double heddles or jacks, in such a manner, and so hanging them on the axle by a short arm, or its equivalent, that in their vibrations neither end of them shall pass beyond a vertical plane passing through the axle on which they rock or oscillate, so that the weight of the jacks shall be thrown outside of their points of suspension; thus counterbalancing the weight of the harness."

16. For an *Improvement in Self-Acting Mules;* Wanton Rouse, Taunton, Massachusetts, November 2.

*Claim.*—"Having fully described my invention, I will proceed to state what I claim, without confining myself to the precise construction and arrangement of the parts, or to the precise manner of operating them.

"1st, I claim backing off or reversing the spindles, to unwind the yarn from them, and regulating or altering the amount of backing off, as the building of the cops progresses, by means of a step or incline of varying form, extending along a revolving cam or its equivalent, substantially such as is exemplified in the part from 5 to 25, on the cam B, the said step or incline governing the revolution of the spindles.

"2d, I claim the mechanism for making the finger through the irregular surface of the cam B, or its equivalent, acts upon the mechanism which drives the spindles in backing off and building on, to traverse the said cam, or equivalent, and keep it to the surface, consisting of the screws, the nut, the cord or chain, the lever, and stud, operating in combination, in the manner substantially as described."

17. For an *Improvement in Machines for Drilling Stone;* Lemuel P. Jenks, Boston, Assignor to Joseph W. Page, West Roxbury, Assignor to George A. Gardner, Boston, Massachusetts, November 2.

"The nature of my invention consists in providing an arrangement, whereby a reciprocating motion of a drill in combination with a rotation of the said drill is secured, in connexion with a contrivance for feeding forward the said drill into the rock; with this, I have also a contrivance, whereby I can at pleasure graduate the rapidity of the rotation, and also the rapidity of the feeding forward of the same, by either one movement or by two separate movements."

*Claim.*—"The arrangement of the mandrel head, pawl, and ratchet wheel, as sunken into the cross head, I believe to be an original and valuable improvement; but I do not think it necessary to claim it. The same remark applies to that of the cross cut valve, as applied to steam drills; though since my invention of it, I have learned that a similar arrangement has been applied to pumps. The same remark as to originality and valve, applies to the arrangement of the bars or rods, to effect the turning movements, as swinging on their centres; but I do not feel certain as to their priority, and have not at present the opportunity to ascertain: I therefore do not claim that priority. The side swinging of the frames bearing the drill, is also a new and valuable feature; but I do not think it necessary to claim it.

"But the claim which I do make herein as for my own invention is, the arrangement, (in a swinging or other frame,) for the purpose of drilling rods, of two cross heads, the one with a reciprocating motion, and the other connected therewith and bearing the drill, with a reciprocating and progressively advancing motion, substantially as described; and this, however such alternate advance and recession may be effected.

"I also claim the arrangement of, substantially, a sliding bar, for the purpose of changing both the rate of rotation and the rate of advance of the drill, by one movement, for the purpose and in the manner substantially as described.

"I do not claim the ratchet wheel and pawl holder, operated by the inclined groove, by itself; but I claim the making the ratchet cylinder, or equivalent rotating arrangement, sliding upon the mandrel or drill stock as the same advances, in such manner as that the pawl holder projection retains its place in the inclined groove, substantially as herein described."

18. For an *Improvement in Sewing Machines;* John G Bradeen, Boston, Assignor to himself and George Perkins, Malden, Massachusetts, November 2.

*Claim.*—"I claim as my improvement the two rotating draft hooks, or their equivalent, separate from the needles, in combination with the two needles and two thread guides, made to be operated together substantially as specified.

"And I claim the improvement of so constructing and operating the needles and thread guides, that each needle, directly after passing into and through the cloth, shall pass through the thread guide which is on that side of the cloth opposite to the side of it in which the needle first enters; meaning to claim the arrangement of each needle and its thread guide, respectively, on opposite sides of the cloth, they being constructed and operated in the manner specified. In F. R. Robinson's machine, they are arranged and made to operate on the same side of the cloth.

"And I also claim the combination of the rocking thread lifter, or its equivalent, with the needle and presser, the said thread lifter being operated as described, by the thread guide lever, or any other proper means."

19. For an *Improvement in Hand Seed Planters;* William Bullock, Philadelphia, Pennsylvania, November 2.

*Claim.*—"What I claim therein as new and of my invention is, 1st, A seed planter, having a tube or tubes, which, in operating the planter, is or are closed when placed in the ground, and so arranged that it or they can be opened while in the ground, for the purpose of letting the seeds out.

"2d, The arrangement of two or more tubes in such a manner, that the operator can place the seeds in a hill, at specified distances apart.

"3d, The feeders, having a sloping cavity at the outer ends, and being so arranged that as the seeds are carried up, they will slide out and pass into the tubes.

"And, 4th, the arrangement of the feeders and jaws or valves of the tubes, in connexion with the handle, by which the machine is carried, so that the feeder and jaws or valves can be operated by the same hand with which the machine is carried."

# MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

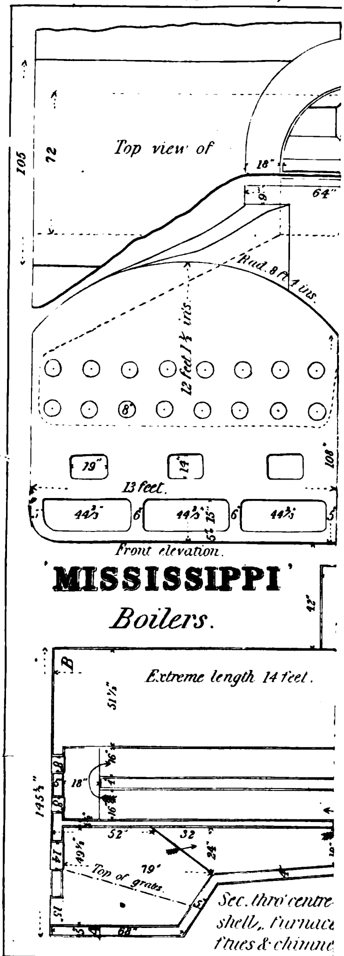
## *United States Steam Frigate Mississippi.* By Chief Engineer B. F. Isherwood, U. S. Navy.

The steam frigate *Mississippi*, built at Philadelphia, and launched May 21, 1841, may be considered as the commencement of the United States steam marine; her sole predecessor, the *Fulton*, being adapted for harbor defence only, and incapable of ocean navigation. The *logs* for the *Mississippi's* entire time of steaming having lately come into my hands, I have prepared carefully from them a summary of her performance, which will be found in tables 1, 2, 3, and 4, hereafter given. These tables embrace all that portion of the vessel's performance where the logs were full, and where the steaming was uninterrupted for such a length of time, with unchanged conditions of weather, sea, throttle, cut-off, steam, &c., as to promise reasonable accuracy for the mean. They of course exclude a considerable amount of steaming for short distances, and where the logs are imperfect and unreliable.

In examining these tables, the reader must bear in mind the manner in which the data was obtained. The speed of the vessel was ascertained by the common chip log, and the result is probably in no case within half a knot of the truth; as a general thing, the speed is over-logged. The double strokes of piston were occasionally obtained from a counter, but generally by counting by the sand glass every quarter hour, and logging the mean—not a very close approximation. The steam pressure was obtained in a similar manner, by taking a mean of quarter hour observations; while the expenditure of coal was taken by *measure*, instead of *weight*—a certain average weight being allowed for each measure; of course, there were inevitable errors here, owing to the measure never being filled twice alike, and also to the fact, that the same measure of larger lumps would weigh less than the same measure of smaller lumps.

The state of the sea, the direction and kind of wind, &c., recorded in the logs, are very unreliable, as they are judged of entirely according to the fancies and sensations of the observers. What would be called a rough sea by one, would be called a moderate sea by another, and so on. The direction of the wind, as well as its force, is the *apparent* direction and force to an observer on the vessel's deck; where, owing to the progressive movement of the vessel, what appears to be, and is logged as a gentle wind ahead, is in fact a calm, while a calm is a gentle wind aft, and so on. For the same reason, a wind whose direction is logged forward the beam, has its direction abaft the beam.

Still, notwithstanding all these errors, the mean of many hours' performance, by the resulting correction of errors thereby obtained, may be depended on as a reasonably close approximation to the truth, sufficiently so for all practical purposes; for the probability is the same, that of a number of observations varying from the truth, as many will be too high as too low; the greater, therefore, the number of observations the nearer will the mean approach the truth. From these considerations, I am per-

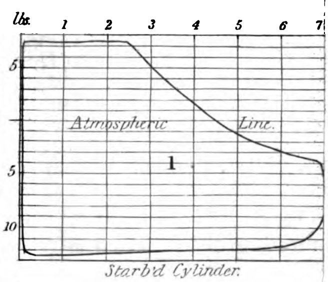



'MISSISSIPPI'

Boilers.

Indicator Diagrams

U.S.S. Mississippi.



suaded that the *means* of tables 1, 2, 3, and 4, may be received and argued upon with confidence. Before, however, discussing their results, it will be useful to give the dimensions of the vessel, machinery, &c., the former of which I have obtained from the constructor.

| | |
|---|---|
| HULL.—Length over all, | 228 feet 9 inches. |
| Length from aft side of rabbet of post at cross seam to fore side of rabbet of stern at the height of first port-sill, | 223 " |
| Extreme breadth, | 40 " |
| Moulded breadth, | 39 " |
| Height from lower edge of rabbet of keel to first port-sill amidships, | 28 " |
| Depth of hold, | 23 " 6 " |
| Depth of keel and false keel, clear of bottom plank, | 2 " |
| Mean (Constructor's) load draft, *inclusive* of keel, &c., (2 feet,) | 20 " 1½ " |
| Length of mean load line, including both rabbets, | 219·71 feet. |
| Area of immersed amidship section at 20 feet 1½ inch mean draft, | 651·3 square feet. |
| Area of mean load line, | 7701 " " |

*Displacements at the following mean drafts of water, including keel.*

| Drafts. | Tons of sea water. 2240 lbs. per ton. |
|---|---|
| 12 feet, | 1332·16 |
| 14 " | 1723·68 |
| 16 " | 2132·81 |
| 18 " | 2556·52 |
| 20 " | 2991·80 |
| 20 " 1½ inch, | 3022·00 |

*Weights of hull and every thing ready for cruising, except machinery and fuel.*

| | Tons of 2240 lbs. |
|---|---|
| Hull, | 1279·30 |
| Masts, yards, &c., | 52·21 |
| Spare spars, | 5·73 |
| Rigging, blocks, and iron work for rigging, | 30.13 |
| Sails and awnings, | 10·22 |
| Cables, anchors, and appurtenances, | 63·66 |
| Nine boats, with oars, | 10·47 |
| Armament, (gun carriages, pivots, breachings, &c., for two 10-inch and four 8-inch guns,) | 32·90 |
| Cases for powder, | 5·24 |
| Powder, | 2·02 |
| Shell and shot boxes, | 1·11 |
| Forty solid 8-inch shot, | 1·25 |
| Tanks, casks, kids, cans, &c., | 19·02 |
| 15,092 gallons of water at 8·34 pounds, | 56·20 |
| Provisions for 200 men for four months, | 43·50 |
| 226 men, with baggage, at 225 pounds, (no engineer or fireman,) | 22·70 |
| Fuel for galley, | 21·60 |
| Galley and fixtures, | 4·70 |
| Furniture for cabin, ward room, &c., | 2·73 |
| Master's stores, | 1·80 |
| Carpenter's " | 5·83 |
| Gunner's " | 4.02 |
| Boatswain's " | 8·95 |
| Surgeon's, Purser's, and Officer's stores, | 3·52 |
| Engineer's stores, | 8·34 |
| Engineers and Firemen, | 4·42 |
| Total, | 1701·57 |

RIG.—The *Mississippi* is barque-rigged, and spreads 19,030 square feet of canvass in the nine principal sails.

Engines.—Two side lever engines, with cast iron frames, and balance puppet steam and exhaust valves. The steam valve is used with Stevens' arrangement, as a cut-off valve.

| | |
|---|---|
| Diameter of cylinders, | 75 inches. |
| Stroke of piston, | 7 feet. |
| Space displacement of both pistons per stroke, | 429·5 cubic feet. |
| Diameters of the disks of the steam and exhaust valves, | 13¾ and 14¾ inches. |
| Area of steam and also area for exhaust through the valves, each, | 319·362 square " |
| Diameter of air pump, | 46½ inches. |
| Stroke of air pump piston, | 3 feet 8 " |
| Space displacement of both pistons of air pumps per stroke, | 86·5 cubic feet. |
| Capacity of condensers, | 150 " " |
| Diameter of main shaft, | 17 inches. |
| Steam space between cut-off valves and pistons, one end of both cylinders, | 21·52 cubic feet. |
| Length occupied by engines alone, | 31 feet. |

*Weight of Engines complete.*

| | |
|---|---|
| Cast iron, | 430,769 pounds. |
| Wrought iron, | 250,582 " |
| Wrought copper, | 16,496 " |
| Wrought steel, | 1,138 " |
| Brass castings, | 35,470 " |
| Total, | 734,455 " |

Paddle Wheels.—Diameter from outside to outside of rings, 30 feet.

| | |
|---|---|
| Number of paddles in each wheel, | 21. |
| Length of each paddle, | 11 feet. |
| Width " " | 30 inches |

*Weight of Paddle Wheels complete.*

| | |
|---|---|
| Cast iron, | 16,579 pounds. |
| Wrought iron, | 29,368 " |
| Oak paddles, | 14,448 " |
| Total, | 60,395 " |

Boilers.—(Plate III.)

Four copper boilers, with double return ascending flues. The boilers are placed in pairs, back to back, with one smoke chimney in common.

| | |
|---|---|
| Length of each boiler, including its smoke connexions, | 16 feet 9 inches. |
| Breadth " " | 13 " |
| Height " " exclusive of steam chimney, | 12 " 1½ " |
| Solidity of the circumscribing parallelopipedon of each boiler, | 2640·22 cubic feet. |
| Area of the total heating surface in the four boilers, | 5400 square " |
| " " grate " " " | 268 " " |
| Aggregate cross area of lower arches at bridge in the four boilers, | 72·026 " " |
| " " " " " at back end of boiler " | 52·693 " " |
| " " " of middle row of flues in the four boilers, | 44·68 " " |
| " " " of upper " " " " | 44·68 " " |
| Cross area of the smoke chimney, | 44·18 " " |
| Height of smoke chimney above the grates, | 65 feet. |
| Capacity of steam room in the four boilers and steam chimney, | 1770 cubic feet. |
| " " " " " steam chimney, and steam pipes, | 1876 " " |

Proportions.—Proportion of heating to grate surface, 20·149 to 1·000

| | |
|---|---|
| Proportion of grate surface to aggregate cross area of lower arches at bridge, | 3·721 " |
| " " " " of lower arches at back of boiler, | 5·086 " |
| " " " " of middle row of flues, | 6·000 " |
| " " " " of upper " " | 6·000 " |
| " " " " of smoke chimney, | 6.066 " |
| Square feet of heating surface per cubic foot of space displacement of pistons per stroke, | 12·573. |
| Square feet of grate surface per cubic foot of space displacement of pistons per stroke, | 0·544. |

*Weights.*

| | | |
|---|---|---|
| Brass castings, | 16,182 | pounds. |
| Iron castings, exclusive of grate bars, | 2,427 | " |
| Grate bars, (165 pairs and 12 single bars,) | 22,079 | " |
| Wrought iron, exclusive of smoke chimney, | 17,509 | " |
| Iron smoke chimney, | 11,468 | " |
| Wrought copper, | 681 | " |
| Four copper boilers and steam chimney, including braces and rivets only, not other appurtenances, | 227,811 | " |
| Total weight of boilers and appurtenances, | 298,157 | " |
| Weight of sea water in the four boilers, | 183,680 | " |
| The coal bunkers weigh | 38,276 | " |
| And contain of bituminous coal, | 550 | tons. |

*Cost of the Mississippi.*

| | |
|---|---|
| Cost of labor, all inclusive except machinery, | $129,344 |
| " materials, | 175,020 |
| " machinery, except boilers, | 167,583 |
| " boilers, | 81,901 |
| Total cost of vessel, | $553,848 |

In the construction of the engines there was employed labor 16,658¼ days, at the average rate of $2·25 per day. Labor on patterns, 2302¾ days.

*Repairs on the Hull of the Mississippi.*

| | |
|---|---|
| Cost of repairs done in 1845, | $10,300 |
| " " 1847, | 8,740 |
| " " 1848, | 3,630 |
| " " 1849, | 66,060 |

*Repairs on the Machinery of the Mississippi.*

| | |
|---|---|
| Cost of repairs done in 1845, | $17,841 |
| " " 1847, | 2,855 |
| " " 1848, | 1,335 |
| " " 1849, | 61,967 |
| " " 1852, | 72,952 |

The total length in the vessel occupied by engines, boilers, coal bunkers, paddle wheels, and fire and engine rooms, is 113 feet.

### Performance of the Mississippi.

The performance of the *Mississippi* has been divided into four parts, and a summary of each given in tables 1, 2, 3, and 4. Tables 1 and 2 comprise the steaming done on the coast of the United States, in the Atlantic Ocean, and in the Gulf of Mexico; with the diameter of the paddle wheels 28 feet from outside to outside of paddles, and burning the Cumberland bituminous coal. In table 1 is given the performance under steam alone; in table 2 is given the performance under steam and sail.

Tables 3 and 4 comprise the steaming done in the Mediterranean and in crossing the Atlantic, from June 8th to June 12th, 1849, making 24 hours in table 3, and 60 hours in table 4. The paddle wheels were 28 feet diameter from outside to outside of paddles, and for the remainder of the performance contained in these tables it was 29 feet from outside to outside of paddles.

TABLE I.—PERFORMANCE OF THE MISSISSIPPI UNDER STEAM ALONE IN THE ATLANTIC OCEAN AND GULF OF MEXICO, BETWEEN OCTOBER 24, 1845, AND MARCH 13, 1847.

| DATE. | | Number of hours. | Speed of vessel in knots of $6082\frac{2}{3}$ feet per hour. | WIND. Direction. | WIND. Kind. | State of the sea. | ENGINES. Double strokes of piston per minute. | ENGINES. Steam pressure in boiler above atmosphere in pounds per sq. inch. | ENGINES. Steam cut off at, from commencement of st'k of piston, in inches. | ENGINES. Throttle open. | ENGINES. Vacuum in condenser in in. of mer'y pr. gauge. | Pounds of coal consumed per hour. | Immersion of lower edge of paddles, in feet and inches. | HULL. Mean draft in feet and inches. | HULL. Area of immersed amidship section, in sq. ft. | HULL. Displacement of sea water, in tons of 2240 pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oct. 24 to Oct. 26, | 1845 | 72 | 6·867 | Ahead. | Fresh wind. | Rough. | 11·300 | 12·9 | 38 | $\frac{7}{8}$ | $26\frac{1}{2}$ | 3963 | 5 11 | 18 9 | 596·3 | 2718·9 |
| Oct. 27 to Oct. 28, | " | 36 | 7·940 | " | Light airs. | Moderate. | 13·100 | 12·9 | " | Wide. | " | 4824 | 5 8 | 18 6 | 586·3 | 2663·8 |
| March 24 and 25, | 1846 | 34 | 7·212 | On bow. | Fresh breeze. | " | 9·912 | 10·9 | 26 | " | $27\frac{1}{2}$ | 2666 | 7 0 | 19 8 | 633·0 | 2920·0 |
| March 27 and 28, | " | 23 | 7·335 | Abeam. | Light breeze. | Smooth. | 10·522 | 11·6 | " | $\frac{3}{4}$ | " | 2633 | 6 9 | 19 5 | 623·0 | 2865·9 |
| March 31 to April 3, | " | 84 | 7·743 | Ahead. | Gentle breeze. | " | 12·800 | 13·0 | 34 | Wide | " | 4226 | 5 8 | 18 6 | 586·3 | 2663·8 |
| May 5 to May 9, | " | 114 | 6·905 | " | " " | Moderate. | 10·214 | 10·4 | 36 | " | " | 3072 | 6 4 | 19 0 | 606·3 | 2774·0 |
| May 10 to May 17, | " | 48 | 7·077 | Abeam. | Moderate " | " | 10·848 | 9·4 | 32 | $\frac{3}{4}$ | " | 2652 | 6 7 | 19 3 | 616·3 | 2829·1 |
| June 1 to June 3, | " | 58 | 6·984 | " | Gentle " | Smooth. | 9·207 | 14·2 | 26 | Wide. | " | 2378 | 7 0 | 19 8 | 633·0 | 2921·0 |
| June 20 and 21, | " | 28 | 6·250 | Ahead. | " " | " | 9·000 | 9·5 | 34 | " | " | 2500 | 6 10 | 19 6 | 626·3 | 2884·2 |
| June 27 to July 1, | " | 44 | 6·750 | Abeam. | " " | " | 10·273 | 12·6 | " | " | " | 3129 | 5 9 | 18 7 | 589·6 | 2681·7 |
| October 4 and 5, | " | 48 | 7·256 | Variable. | Light airs. | " | 10·850 | 11·9 | 32 | " | " | 2727 | 6 10 | 19 6 | 626·3 | 2884·2 |
| November 18 and 19, | " | 36 | 7·333 | Abeam. | Fresh breeze. | Rough. | 10·567 | 11·8 | 35 | " | " | 3102 | 6 10 | 19 6 | 626·3 | 2884·2 |
| Nov. 24 to Nov. 28, | " | 100 | 4·708 | On bow | Moderate gale. | Heavy ahead. | 8·114 | 7·9 | 37 | $\frac{3}{4}$ | " | 2172 | 5 10 | 18 8 | 593·0 | 2700·5 |
| Dec. 26, '46, to Jan. 12, '47 | | 204 | 6·396 | " | Strong wind. | " " | 11·071 | 9·6 | " | " | " | 3072 | 5 8 | 18 6 | 586·3 | 2663·8 |
| March 8 to March 15, | " | 152 | 6·746 | " | Moderate " | Moderate " | 9·000 | 10·5 | 32 | Wide. | " | 3229 | 6 8 | 19 4 | 619·6 | 2847·5 |
| Oct. 21 to March 13, | " | 167 | 7·724 | " | Gentle breeze. | Smooth. | 11·289 | 11·9 | 39 | $\frac{3}{4}$ | " | 2963 | 5 10 | 18 8 | 593·0 | 2700·5 |
| Means, | | | 6·868 | | | | 10·486 | 11·0 | 35 | $\frac{7}{8}$ | $27\frac{1}{2}$ | 3093 | 5 11 | 18 9 | 596·3 | 2718·9 |

TABLE II.—PERFORMANCE OF THE MISSISSIPPI UNDER STEAM AND SAILS SET TO TOPSAILS, IN THE ATLANTIC OCEAN AND GULF OF MEXICO, BETWEEN MARCH 26, 1846, AND OCTOBER 20, 1847.

| DATE. | | Number of hours. | Speed of vessel in knots of 6082⅔ feet per hour. | WIND. Direction. | WIND. Kind. | State of the sea. | ENGINES. Double strokes of piston per minute. | ENGINES. Steam pressure in boiler above atmosphere in pounds per sq. inch. | ENGINES. Steam cut off at, from commencement of st'k of piston, in inches. | ENGINES. Throttle open. | ENGINES. Vacuum in condenser in in. of mer'y pr. gauge. | Pounds of coal consumed per hour. | Immersion of lower edge of paddles, in feet and inches. | HULL. Mean draft in feet and inches. | HULL. Area of immersed amid-ship section, in sq. ft. | HULL. Displacement of sea water in tons of 2240 pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| March 26 and 27, | 1846 | 35 | 8·030 | Abeam. | Moderate. | Moderate. | 10·812 | 11·0 | 26 | Wide. | 27½ | 2658 | 6 10 | 19 6 | 626·3 | 2884·2 |
| May 10 to May 12, | " | 27 | 6·975 | " | Gentle. | " | 10·268 | 6·3 | 36 | ½ | " | 2329 | 6 10 | 19 6 | 626·3 | 2884·2 |
| May 15 and 16, | " | 25 | 7·040 | Abaft the beam | Moderate. | " | 9·660 | 6·4 | 28 | 3-16 | " | 1702 | 6 2 | 18 10 | 599·7 | 2737·2 |
| May 31 and June 1, | " | 25 | 7·380 | Abeam. | " | Rough. | 10·844 | 13·3 | 30 | Wide. | " | 3414 | 7 0 | 19 8 | 633·0 | 2921·0 |
| June 21 to June 24, | " | 80 | 6·341 | Abaft the beam | " | Smooth. | 8·130 | 5·6 | 24 | 3-16 | " | 800 | 7 0 | 19 8 | 633·0 | 2921·0 |
| June 29, | " | 12 | 8·500 | Abeam. | " | " | 11·100 | 11·1 | 33 | Wide. | " | 3540 | 5 11 | 18 7 | 589·6 | 2681·7 |
| July 1, | " | 10 | 8·300 | " | " | " | 12·300 | 12·7 | 33 | " | " | 2200 | 5 10 | 18 6 | 586·3 | 2663·8 |
| October 1 to October 3, | " | 67 | 7·436 | Abaft the beam | " | " | 10·494 | 11·3 | 32 | " | " | 2422 | 7 2 | 19 10 | 639·7 | 2957·4 |
| Nov. 15 to Nov. 24, | " | 40 | 8·020 | For'd the beam | Fresh. | Rough. | 11·110 | 9·7 | 35 | " | " | 2880 | 6 10 | 19 6 | 626·3 | 2884·2 |
| December 3, | " | 20 | 8·000 | Aft. | Moderate. | Smooth. | 12·500 | 11·1 | 33 | " | " | 3929 | 7 0 | 19 8 | 633·0 | 2921·0 |
| Dec. 26 to Dec. 31, | " | 27 | 7·022 | Abeam. | " | Moderate. | 9·945 | 7·3 | 34 | ¼ | " | 2395 | 6 7 | 19 3 | 616·3 | 2829·1 |
| January 10 and 11, | 1847 | 28 | 8·871 | " | " | Rough. | 13·107 | 10·2 | 26 | Wide. | " | 3134 | 6 7 | 19 3 | 616·3 | 2829·1 |
| March 14, | " | 14 | 7·145 | Abaft the beam | Light. | Smooth. | 9·000 | 8·0 | 26 | 3-16 | " | 1300 | 6 2 | 18 10 | 599·7 | 2737·2 |
| Oct. 18 to Oct. 20, | " | 72 | 7·750 | " " | Moderate. | " | 9·767 | 9·4 | 36 | Wide. | " | 2647 | 7 7 | 20 3 | 656·3 | 3049·6 |
| March 16 to March 18, | " | 48 | 8·210 | Aft. | Fresh. | " | 8·900 | 7·7 | 30 | 1-32 | " | 1721 | 6 2 | 18 10 | 599·7 | 2737·2 |
| March 19. | " | 12 | 9·500 | " | " | " | 12·500 | 8·3 | 30 | ¾ | " | 3120 | 6 0 | 18 8 | 593·0 | 2700·5 |
| Means, | | | 7·574 | | | | 10·174 | 9·0 | 30 | 11-16 | 27½ | 2305 | 6 10 | 19 6 | 626·3 | 2884·2 |

TABLE III.—Performance of the Mississippi under steam alone in the Atlantic and Mediterranean, between June, 1849, and November, 1851.

| Date. | | Number of hours. | Speed of vessel in knots of 6082⅔ feet per hour. | Wind. Direction. | Wind. Kind. | State of the sea. | Engines. Double strokes of piston per minute. | Engines. Steam pressure in boiler above atmosphere in pounds per sq. inch. | Engines. Steam cut off at, from commencement of st'k of piston, in inches. | Engines. Throttle open. | Engines. Vacuum in condenser in in. of mer'y pr. gauge. | Pounds of coal consumed per hour. | Immersion of lower edge of paddles in feet and inches. | Hull. Mean draft in feet and inches. | Hull. Area of immersed amid-ship section in sq. ft. | Hull. Displacement of sea water in tons of 2240 pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| June 8, | 1849 | 12 | 7·750 | Abeam. | Moderate. | Smooth. | 8·667 | 7·6 | 35 | Wide. | 27½ | 2254 | 7 11 | 20 7 | 669·7 | 3123·0 |
| June 10, | " | 12 | 8·167 | Ahead. | Gentle. | " | 9·825 | 10·5 | 33 | " | " | 2361 | 7 8 | 19 10 | 639·7 | 2957·4 |
| June 18 to June 27, | " | 176 | 8·500 | On bow. | " | " | 11·860 | 9·4 | 33 | " | " | 2722 | 5 8 | 17 10 | 559·7 | 2517·1 |
| July 9 to Oct. 23, | " | 252 | 7·405 | " | " | " | 10·821 | 10·5 | 30 | " | " | 2611 | 6 10 | 19 0 | 606·3 | 2774·0 |
| Feb. 17 to June 3, | 1850 | 108 | 7·120 | " | " | " | 10·760 | 10·7 | 20 | " | " | 2464 | 6 10 | 19 0 | 606·3 | 2774·0 |
| June 17 and 18, | " | 23 | 7·609 | " | Light. | " | 10·891 | 11·1 | 40 | " | " | 3068 | 6 11 | 19 1 | 609·6 | 2794·4 |
| July 28 to Nov. 8, | " | 92 | 7·044 | " | " | " | 10·206 | 10·3 | 28 | " | " | 2500 | 6 7 | 18 9 | 596·6 | 2718·9 |
| Feb. 25 to April 13, | 1851 | 48 | 8·063 | Ahead. | Gentle. | " | 11·750 | 11·3 | 25 | " | " | 3498 | 6 2 | 18 4 | 579·6 | 2627·1 |
| April 19 to May 14, | " | 160 | 7·913 | " | Light. | " | 10·188 | 10·4 | 29 | " | " | 2815 | 6 4 | 18 6 | 586·3 | 2663·8 |
| May 23 to July 2, | " | 233 | 7·614 | On bow. | " | " | 11·150 | 10·1 | 30 | " | " | 2816 | 6 10 | 19 0 | 606·3 | 2774·0 |
| July 3 and 18, | " | 36 | 7·611 | Abaft beam. | Gentle. | " | 11·444 | 10·6 | 32 | " | " | 3024 | 5 10 | 18 0 | 566·3 | 2553·8 |
| July 21 to August 20, | " | 149 | 7·846 | Forward beam. | Light. | " | 10·886 | 8·3 | 26 | " | " | 2645 | 6 4 | 18 6 | 586·3 | 2663·8 |
| Aug. 29 to Oct. 5, | " | 270 | 7·944 | On bow. | Gentle. | " | 10·083 | 9·2 | 24 | " | " | 2605 | 6 8 | 18 10 | 599·7 | 2737·2 |
| October 16 and 17, | " | 40 | 7·550 | " | Moderate. | " | 9·300 | 9·8 | 26 | " | " | 2460 | 7 10 | 20 0 | 646·3 | 2994·4 |
| Oct. 19 to Oct. 23, | " | 90 | 6·722 | Ahead. | Gentle. | " | 8·572 | 9·1 | 26 | " | " | 2290 | 7 10 | 20 0 | 646·3 | 2994·4 |
| November 1, | " | 24 | 7·500 | " | Light. | " | 10·509 | 10·2 | 26 | " | " | 2480 | 6 2 | 18 4 | 579·6 | 2627·1 |
| November 5, | " | 24 | 6·917 | On bow. | Moderate. | " | 10·317 | 10·2 | 27 | " | " | 3135 | 5 6 | 17 8 | 553·0 | 2480·4 |
| Means, | | | 7·675 | On bow. | Gentle. | Smooth. | 10·623 | 9·8 | 28 | Wide. | 27½ | 2561 | 6 7 | 18 9½ | 598·0 | 2728·1 |

TABLE IV.—PERFORMANCE OF THE MISSISSIPPI UNDER STEAM AND SAIL SET TO TOPSAILS, IN THE ATLANTIC AND MEDITERRANEAN, BETWEEN JUNE, 1849, AND NOVEMBER, 1851.

| DATE. | | Number of hours. | Speed of vessel in knots of 6082⅔ feet per hour. | WIND. Direction. | WIND. Kind. | State of the sea. | ENGINES. Double strokes of piston per minute. | ENGINES. Steam pressure in boiler above atmosphere in lbs. per sq. in. per gauge. | ENGINES. Steam cut off at, from commencement of st'k of piston in inches. | ENGINES. Throttle open. | ENGINES. Vacuum in condenser in. in. of mer'y per gauge | Pounds of coal consumed per hour. | Immersion of lower edge of paddles in feet and inches. | | HULL. Mean draft in feet and inches. | | HULL. Area of immersed amid-ship section in sq. ft. | HULL. Displacement of sea water in tons of 2240 pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| June 8 and 9, | 1849 | 36 | 8·017 | | Moderate. | Moderate. | 9·444 | 9·1 | 34½ | Wide. | 27½ | 2443 | 7 | 10 | 20 | 6 | 666·3 | 3104·7 |
| June 11 and 12, | " | 24 | 8·750 | Abeam. | Strong. | Smooth. | 9·541 | 10·7 | 33 | " | " | 2371 | 7 | 7 | 20 | 3 | 656·3 | 3049·6 |
| June 26, | 1851 | 8 | 7·000 | Aft. | Moderate. | " | 10·450 | 8·5 | 30 | " | " | 2520 | 6 | 11 | 19 | 1 | 609·6 | 2794·4 |
| July 19, | " | 24 | 9·166 | Abeam. | " | " | 12·604 | 7·7 | 36 | " | " | 3024 | 5 | [illegible] | 17 | 7 | 549·6 | 2461·2 |
| July 20, | " | 24 | 8·833 | On quarter. | Strong. | Moderate. | 11·804 | 7·7 | 36 | " | " | 3024 | 5 | 3 | 17 | 5 | 543·0 | 2424·6 |
| August 21, | " | 12 | 8·583 | Abeam. | Light. | Smooth. | 10·192 | 9·4 | 24 | " | " | 2520 | 6 | 0 | 18 | 2 | 573·0 | 2590·3 |
| October 18, | " | 24 | 9·000 | Forward beam. | Strong gale. | Moderate. | 10·150 | 9·1 | 26 | ½ | " | 2261 | 7 | 10 | 20 | 0 | 646·3 | 2994·4 |
| October 26 and 27, | " | 48 | 8·250 | Aft. | " | " | 11·208 | 9·0 | 26 | Wide. | " | 1925 | 6 | 11 | 19 | 1 | 609·6 | 2794·4 |
| October 28 and 29, | " | 48 | 7·000 | Forward beam. | Strong. | " | 8 277 | 9·1 | 26 | ⅛ | " | 1570 | 6 | 10 | 19 | 0 | 606·3 | 2774·0 |
| Nov. 2 to Nov. 4, | " | 60 | 8·117 | " | " | Smooth. | 11·233 | 10·4 | 24 | Wide. | " | 2698 | 5 | 9 | 17 | 1 | 563·0 | 2535·2 |
| Nov. 6 to Nov. 9, | " | 82 | 8·573 | " | " | " | 12·452 | 9·5 | 25 | " | " | 3144 | 5 | 3 | 17 | 5 | 543·0 | 2424·6 |
| Means, | | | 8·302 | Strong. | Strong. | Smooth. | 10·858 | 9·4 | 28 | Wide. | 27½ | 2518 | 6 | 4 | 18 | 7 | 589·6 | 2681·7 |

In the following comparative summary of the vessel's performance, the evaporation obtained from the fuels has been calculated, using Regnault's tables of the latent heat of steam. The initial pressure in the cylinder was obtained from a collacation of many indicator diagrams. The temperature of the feed water entering the boilers is taken at 100° F., the usual average for condensing engines; and the loss by *blowing off* necessary to prevent the deposition of scale, was calculated on the supposition that the sea water was carried at double the natural concentration, or at $\frac{2}{32}$ of the Sewell salinometer used in the Navy, which is the average concentration. The horses power developed by the engines has been calculated from indicator diagrams.

*Comparative Summary of the Performance of the Mississippi, deduced from the Means of Tables* I, II, III, & IV.

| | Table I. Steam alone. | Table II. Steam and sails. | Table III. Steam alone. | Table IV. Steam and sails. |
|---|---|---|---|---|
| OBSERVED. | | | | |
| Number of hours performance, | 1248 | 542 | 1749 | 390 |
| Speed of vessel per hour in knots of 6082$\frac{2}{3}$ feet, | 6·868 | 7·574 | 7·675 | 8·302 |
| Double strokes of piston made per minute, | 10·486 | 10·174 | 10·623 | 10·858 |
| Steam pressure in boilers above atmosphere in pounds per square inch, . . . | 11·0 | 9·0 | 9·8 | 9·4 |
| Steam pressure in cylinders above atmosphere in pounds per square inch, . . | 9·5 | 7·2 | 8·3 | 7·9 |
| Steam cut off at, from commencement of stroke of piston in inches, . . . . | 35· | 30· | 28· | 28· |
| Throttle open, . . . . . | $\frac{7}{8}$ | 11-16 | Wide. | Wide. |
| Vacuum in condenser, in inches of mercury, | 27$\frac{1}{2}$ | 27$\frac{1}{2}$ | 27$\frac{1}{2}$ | 27$\frac{1}{2}$ |
| Pounds of coal consumed per hour, . | 3093 | 2305 | 2561 | 2518 |
| Immersion of lower edge of paddles in ft. and in., | 5 11 | 6 10 | 6 7 | 6 4 |
| Mean draft of vessel in feet and inches, | 18 9 | 19 6 | 18 9$\frac{1}{2}$ | 18 7 |
| Area of immersed amidship section in sq. feet, | 596·3 | 626·3 | 598·0 | 589·6 |
| Displacement of sea water in tons of 2240 lbs., | 2718·9 | 2884·2 | 2728·1 | 2681·7 |
| CALCULATED. | | | | |
| Mean effective pressure on pistons in pounds per square inch, . . . | 17·70 | 14·00 | 15·00 | 14·75 |
| Horses power developed by the engines, . | 695·73 | 533·92 | 597·30 | 600·34 |
| Slip of the centre of pressure of the paddles in per cents. of their speed, . . | 20·00 | 9·07 | 14·82 | 9·87 |
| Oblique action of the paddles calculated as the squares of the sines of their angles of incidence on the water in per cents, . | 21·65 | 25·68 | 21·64 | 21·60 |
| Pounds of steam evaporated by one pound of coal from sea water of twice the natural concentration, with temperature of feed water, 100° F., including loss by *blowing off* to keep the sea water at twice the natural concentration, . . . . . . | 5·363 | 5·533 | 5·133 | 5·246 |

An examination of this comparative summary shows in a striking manner the influence of *weather* on the performance of a paddle wheel steamer. Comparing the mean of the results from tables 1 and 3, the vessel being under steam alone, we find the draft of water the same, and consequently the resistance of the hull the same; but in table 1, the engines exerted 695·73 horses power, while in table 3 they exerted only 597·30 horses

power, or 14·15 per centum less, the speed of the vessel in the latter case being greater than in the former case by 0·807 knots, or 11·75 per cent. As a reduced slip of the paddles, necessarily resulting from their deeper immersion in table 3, would to a great extent be balanced by an increased loss of effect from their increased oblique action, the efficiency of the paddle wheels in the two cases may be taken at about the same. The friction of the engines may also be considered about equal, as the number of double strokes of piston were nearly the same per minute.

A recurrence to tables 1 and 3 will show the steaming to have been performed in table 1, both in winter and summer, with strong head winds and rough seas, as an average for half the time; while in table 3, the steaming was performed wholly in the summer, with smooth seas, and but gentle breezes ahead—a difference of weather fully sufficient to cause the difference of speed.

Tables 2 and 4 give the performance of the vessel under steam and sail, during the same periods of time for which tables 1 and 3 give it under steam alone. In the case of table 2, the vessel's draft of water was one foot greater than in the case of table 4; while in the latter instance the horses power developed by the engines was 12·44 per cent. greater than in table 2, but the speed was also greater by 0·728 knots, or 9·61 per cent.

The difference of slip in tables 1 and 2 is 10·93 per cent., and in tables 3 and 4 is 5·95 per cent. The greater difference in the first than in the second case is easily accounted for by referring to the tables, where it will be seen that the wind was much stronger in table 2 than in table 4; also, that the paddles had the greatest immersion.

As has been before stated, tables 2 and 4, giving the performance under steam and sail, show a greater speed than tables 1 and 3, giving the performance under steam alone. These differences are respectively 0·706 knot and 0·627 knot, or an increase of speed of 10·28 and 8·17 per cent. The sails, however, assisted but in a trifling manner in the production of this effect, which is owing almost entirely to the fact of the power of the wind being removed from acting against the vessel, ahead, and either applied abaft the beam, to assist her progress, thus counting twice, by deduction and addition, or being applied abeam, producing a negative effect, and counting only by deduction.

### Evaporation by the Boilers.

A reference to the comparative summary shows that the boilers of the *Mississippi* evaporated sensibly the same weight of steam for the same weight of coal, in the performances given in all four tables; the discrepancy being only 0·17 pound of steam, in a mean evaporation of 5·498 pounds of steam per pound of coal, during the performances given in tables 1 and 2; and 0·113 pound of steam per pound of coal, during the performances given in tables 3 and 4, in a mean evaporation of 5·19 pounds of steam per pound of coal. The mean evaporation in all four tables is 5·319 pounds of steam per pound of coal, from which result the maximum differs but 3·86 per cent., and the minimum 5·38 per cent., an amount quite within the ordinary errors of observation. We are, therefore, entitled to conclude that in the boilers of the *Mississippi*, one

pound of Cumberland bituminous coal, which was the kind used during the steaming in tables 1 and 2, produced the same evaporation as one pound of British bituminous coal, which was the kind used during the steaming in tables 3 and 4; consequently, the steam generating qualities of the two coals were equal. This conclusion is also warranted by the similar chemical constitutions of the two coals, which are as follows, on the authority of Prof. W. R. Johnson, for the Cumberland, and the British Admiralty Commission of Playfair and De la Beche, for the British coals:

| | Cumberland Bituminous. Average of 5 kinds. | British Bituminous. Average of 6 kinds. |
|---|---|---|
| Carbon, | 75·05 | 75·21 |
| Volatile matter, | 14·20 | 14·60 |
| Sulphur, | .... | 1·39 |
| Ash, | 9·49 | 8·80 |
| Moisture, | 1·25 | .... |
| | 99.99 | 100·00 |

Indicator Diagrams.—(Plate III.)

Indicator diagrams Nos. 1 and 2, show about the average performance, corresponding to tables 3 and 4.

Diagram No. 7, shows the similar performance, corresponding to table 1.

Diagrams Nos. 3, 4, 5, and 6, are given to show the effect of *throttling*. They were taken on the passage from Smyrna to Constantinople, February 22, 1850.

When No. 3 was taken, the throttle was *close shut;* steam pressure in boilers 6 pounds per square inch above atmosphere; double strokes of piston per minute, 6.

When No. 4 was taken, the throttle was *one-eighth* open; steam pressure in boilers, 5½ pounds per square inch above atmosphere; double strokes of piston per minute, 7.

When No. 5 was taken, the throttle was *one-quarter* open; steam pressure in boilers, 6 pounds per square inch above atmosphere; double strokes of piston per minute, 8½.

When No. 6 was taken, the throttle was *three-eighths* open; steam pressure in boilers, 6 pounds per square inch above atmosphere; double strokes of piston per minute, 9.

Diagrams were continuously taken up to a wide throttle; but after three-eighths open, no further difference was discernible between the boiler and cylinder initial pressures; showing that about half the area of steam valve used was sufficient to pass all the steam required for working the engines at the usual speeds of piston.

Diagrams 8 and 9 are from the *air pumps*. When they were taken, (June 14, 1851,) the vessel was drawing 18 feet 8 inches forward, and 18 feet 5 inches aft. Speed of vessel, 8¼ knots per hour; light wind ahead, and smooth sea; steam pressure in boilers, 12½ pounds per square inch above atmosphere; double strokes of piston per minute, 12; vacuum in condenser, 27¼ inches of mercury; steam cut off in cylinder at 28 inches from commencement of stroke; initial steam pressure in cylinders, 11 pounds per square inch above atmosphere.

Simultaneously with the air pump diagrams, diagrams were taken from the steam cylinders, and gave a mean effective pressure throughout the stroke of 16·9 pounds per square inch of piston. The mean effective pressure throughout the stroke of the air pump pistons was 5·4 pounds per square inch. The space displacement of both steam cylinder pistons being 429·5 cubic feet, and of both air pump pistons 86·5 cubic feet, and the air pump pistons making but one delivering stroke to each double stroke of the steam pistons, the power required to work the air pump will be $\left(\frac{86{\cdot}5}{429{\cdot}5} \div 2 = 0{\cdot}1014, \text{ and } 0{\cdot}1014 \text{ of } 5{\cdot}4 =\right)$ 0·533 pound per square inch of steam cylinder piston; to this must be added the weight of water lifted by the pump, which by the diagrams appear to have filled about one-ninth the capacity of the pump, or to have been $\left(\frac{86{\cdot}5}{9}=\right)$ 9·61 cubic feet, which multiplied by 64·3 pounds, the weight of a cubic foot of sea water, and divided by 3396·4 square inches, the areas of both pumps, give 0·182 pounds per square inch of air pump piston; reducing this in the same proportion as above for the pistons of the steam cylinders, it becomes 0·018 pound per square inch, which added to the previous 0·533 pound, makes the power absorbed in working the air pumps of the *Mississippi* to be 0·551 pound per square inch of the steam cylinder pistons. This is of course exclusive of the friction of the pumps, an amount which can only be estimated.

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Translated for the Journal of the Franklin Institute.

## *Method of Obtaining Positive Direct Impressions upon Glass.* By M. Adolphe Martin.

The simplicity of the employment of the iodized collodion as a sensitive coating, the rapidity with which it receives the luminous impressions, and the delicacy of the picture obtained, have turned all minds towards its exclusive employment. The methods which have been heretofore given refer especially to the obtaining negative pictures, and notwithstanding the remarkable results which have been reached, we cannot but remark the want of harmony and relief of the proofs obtained by these methods.

As I have been employed for some time in this matter, I will soon communicate to the Academy some ameliorations which I have discovered; in the mean time, I think that I shall be rendering a service to photography by communicating a process for obtaining direct positive pictures, as sure as it is easy.

The collodion as I employ it, is composed of an ethereal solution of gun-cotton, (made by heating 2 grammes of pure cotton by 50 grammes of nitrate of potassa and 100 grammes of sulphuric acid; the cotton well washed and well dried is then entirely soluble in a mixture of 10 volumes of ether and 1 volume alcohol;) ether and alcohol are then added, so that the solution is composed of 1 gramme of cotton, 120 grammes ether, and 60 grammes alcohol; there is then added about 1 gramme of nitrate of silver, transformed into iodide and dissolved in 20 grammes alcohol, by means of an alkaline iodide, but iodide of ammonium is preferable.

The plate of glass covered in the ordinary way with a thin coating of this solution, is, before it is dry, plunged into a bath composed of 1 part of distilled water, $\frac{1}{12}$th nitrate of silver, and $\frac{1}{20}$th nitric acid. It is placed in the camera as usual for some seconds. The glass plate is then plunged into a bath of sulphate of protoxide of iron, and then washed with care.

Up to this time the image remains negative; but by plunging it in a bath of the double cyanide of silver and potassium, it becomes positive and complete, if its exposure to the light has been properly managed. There is nothing more to be done than to wash it, coat it with dextrine, and dry it, then frame it in a ground of black velvet.

The bath of cyanides which I use, is the same as that of MM. Ruolz and Elkinton; it is only diluted with about three volumes of water. It is composed of 1 litre of water, 25 grammes cyanide of potassium, and 4 grammes nitrate of silver.

I would remark, in conclusion, that this process always gives me pictures, and that the pictures are always positive. Their perfection only depends on the proper appreciation of the time of exposure.

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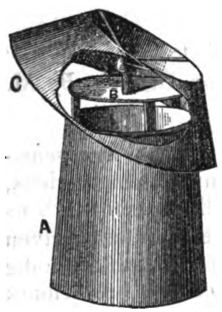
### *Ventilating Wind-Guard. Registered for* M. A. Suter, *Fenchurch Street, London.**




Our illustration of this last new form of wind-guard so clearly explains its construction, as to render our description almost unnecessary. The barrel, A, terminating the flue, has attached, at a short distance above its open upper end, a flat disk, B, so as to leave an annular discharge aperture for the smoke. In the centre of this disk is a short stud, carrying a universal joint on its top, for the purpose of supporting an adjustable open-topped deflector, or saucer-shaped shield, C, part of which is here broken away to show the joint inside. The figure shows its behavior under the action of a side wind, when it affords a very good shield for the windward side, and a very clear smoke passage on the lee. A great point in this contrivance is the arrangement of the centre joint, which allows the shield to turn with the least breath of wind, and thus afford a constant screen.

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Translated for the Journal of the Franklin Institute.

### *Oxygen from Melted Silver. Extract of a Letter from* M. Levol *to* M. Dumas.

As was first observed by Samuel Lucas, pure silver melted in contact with the air absorbs oxygen from it rapidly, and this oxygen is completely disengaged at the moment that the silver becomes solid again. If you desire to extract it during the time that the metal remains fused, you

* From the London Practical Mechanic's Journal, September, 1852.

may do so by means of carbon, which withdraws it by forming carbonic acid; but to separate it in its natural condition appears difficult—nevertheless, it can be accomplished by adding gold in proportion; and in a moment the oxygen is seen to discharge itself so rapidly and so tumultuously as to result in a true effervescence; the matter boils, and rises above the edges of the crucible, even if it be of three or four times the bulk of the melted metals.

Independent of the instruction furnished by this experiment, it furnishes a very curious experiment, and one which a public audience may easily be made to witness.—*Comptes Rendus de l'Academie des Sciences, Paris.*

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## *Gigantic Telescope at Wandsworth Common.**

The construction of a monster reflecting telescope by the Earl of Rosse constituted for a considerable period a prominent topic of interest and conversation in the scientific world. The patience and perseverance of the noble projector under every kind of discouragement, and the unwavering faith with which, at a large outlay to himself, he prosecuted his enterprise to a successful conclusion, secured to him the admiration and esteem of all who took an interest in the higher departments of science, while the discoveries that have since been made through its instrumentality have amply borne out his anticipations and rewarded his exertions. It was necessary, however, that something further should be accomplished. To those not conversant with the subject it may be necessary to state that a reflecting telescope on a large scale must always be a work of exceeding difficulty, and comparatively limited utility. The possibility of constructing an achromatic instrument of a power equal to Lord Rosse's, and through which the object looked at could be directly magnified (as with an opera glass), has long been extremely doubtful; in fact, beyond the reach of mechanical and optical appliances. This desideratum is, however, now on the eve of being supplied.

In the course of a recent ramble on Wandsworth common our attention was attracted by a singularly looking structure, consisting of a plain tower with a long tube slung by its side, surrounded by a wooden boarding to keep off intruders. On making inquiries, we learned that it was a new monster telescope on the achromatic principle in progress of construction, under the superintendence of Mr. W. Gravatt, F. R. S., for the Rev. Mr. Craig, vicar of Leamington. Having obtained an introduction, we inspected the instrument, and ascertained some particulars respecting it which may not be uninteresting. The site, consisting of two acres, has been liberally presented by Earl Spencer in perpetuity, or so long as the telescope shall be maintained. The central tower, consisting of brick, is 64 feet in height, 15 feet in diameter, and weighs 220 tons. Every precaution has been taken in the construction of this building to prevent the slightest vibration; but, if any disappointment in this respect should arise (which, however, Mr. Gravatt does not anticipate), additional weight can be obtained by loading the several floors, and the most perfect steadiness will be thus insured. By the side of this sustaining tower hangs the

* From the London Mechanics' Magazine, August, 1852.

telescope. The length of the main tube, which is shaped somewhat like a cigar, is 96 feet, but with an eye-piece at the narrow end, and a dew-cap at the other; the total length in use will be 85 feet. The design of the dewcap is to prevent obstruction by the condensation of moisture, which takes place during the night, when the instrument is most in use. Its exterior is of bright metal, the interior is painted black. The focal distance will vary from 76 to 85 feet. The tube at its greatest circumference measures 13 feet, and this part is about 24 feet from the object glass. The determination of this point was the result of repeated experiments and minute and careful calculations. It was essential to the object in view that there should not be the slightest vibration in the instrument. Mr. Gravatt, reasoning from analogy, applied the principle of harmonic progression to the perfection of an instrument for extending the range of vision, and thus aiding astronomic research. By his improvements the vibration at one end of the tube is neutralized by that at the other, and the result is that the utmost steadiness and precision is attained. The ironwork of the tube was manufactured by Messrs. Rennie, under the direction of Mr. Gravatt. The object glasses are also of English construction, and throw a curious light upon the manner in which an enlightened, commercial policy has reacted upon and promoted the advancement of science. Up to a recent period the flint glass for achromatic telescopes was entirely of foreign manufacture. Since the reduction of the duty great improvements have been made in this department. The making of the large flint glass was intrusted to Mr. Chance, of Birmingham, who at first hesitated to manufacture one larger than 9 inches in diameter. Upon being urged, however, by Mr. Craig, he has succeeded in producing one 24 inches, perfectly clear, and homogeneous in structure. Besides this, there is a second plate glass of the same dimensions, cast by the Thames Plate Glass Company, either of which the observer may use at his option. The manner in which these object glasses are fitted into the tube is a marvel of artistic invention. By means of twelve screws, numbered according to the hours of the day, they can be set in an instant to any angle the observer may require, by his merely calling out the number of the screw to be used. The object glasses also move round in grooves to whatever position it may be considered that a more distinct view can be gained. The tube rests upon a light wooden frame work, with iron wheels attached, and is fitted to a circular iron railway at a distanceof 52 feet from the centre of the tower. The chain by which it is lowered is capable of sustaining a weight of 13 tons, though the weight ofthe tube is only 3. Notwithstanding the immense size of the instrument, the machinery is such that it can move either in azimuth, or up to an altitude of 80 degrees, with as much ease and rapidity as an ordinary telescope, and, from the nature of the mechanical arrangements, with far greater certainty as to results. The slightest force applied to the wheel on the iron rail causes the instrument to move horizontally round the central tower, while a wheel at the right hand of the observer, by a beautiful adaptation of mechanical powers, enables him to elevate or depress the object glass with the greatest precision and facility. So easy, in fact, is the control over the instrument in this respect, that a very slight touch on the wheel lifts 10 cwt. It may be observed, also, that there cannot be the slightest flexure in the

tube; no error or deflexion arising from that cause can occur, while the ease with which it can be directed towards any point of the heavens will enable the observer to make profitable use of any patch of clear sky, however transient it may be. The great value of this need not be pointed to those accustomed to making astronomical observations. With respect to the magnifying power of this novel instrument, it is only neeessary to state that, though the focus is not so sharp as it will be shortly, it has already separated the nebulæ in the same way as Lord Rosse's. It has separated some of the double stars in the Great Bear, and shown distinctly a clear distance of 50 or 60 degrees between them, with several other stars occupying the intervening spaces. Ordinary readers will better understand the extraordinary magnifying power of the telescope when we inform them that by it a quarter inch letter can be read at the distance of half a mile.

The preparations for this really national work have been progressing for the last two years under the superintendence of Mr. Gravatt as engineer and mathematician, but is only about three months since the superstructure at Wandsworth common was commenced, and it is already near completion.

We understand that the Observatory is likely to be endowed by its liberal and enlightened creator. It will not only be a lasting monument to his enterprising devotion to science, but an admirable illustration of the perfection to which the mechanical arts have attained in this country.

Lord Rosse has visited the Observatory, and expressed his admiration of this novel and interesting invention.—*Times.*

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## *On the Manufacture of Hydrocarbon Coal Gas from Boghead Coal.* By ANDREW FYFE, Esq., M. D., F. R. S. E.*

Continued from page 353.

I come now to consider the question of economy. Assuming that my experiments prove that there is no gain in the amount of light by the combustion of the gas from a ton of Boghead coal by the water process, a question here arises, may not the large quantity of hydrocarbon gas be manufactured at a less expense than the gas from the coal alone? That it may be so per 1000 feet we can easily imagine; but this is not the question to be solved. Gas, like other articles, ought to be paid for according to its value. The more light that 1000 feet will yield when properly consumed, the more ought to be paid for it; of course, the consumer ought to keep this in view, viz., the lower the quality of the gas that he burns, the less ought he to pay for it. I fear that this has not been attended to by those who have so strongly advocated the manufacture of a larger quantity of gas from coal by the addition of other substances, such as the "hydrocarbon" process. I enter upon this part of the subject with diffidence, because I have no satisfactory trials of my own on the results of which I can found calculations. In the trials which I have above recorded, I found that 2 lbs. of charcoal were consumed in the water retort, when 7 lbs. of coal were carbonized in the

* From the London Mechanics' Magazine, July, 1852.

other; and that, to bring out the best results, the quantity of water to be passed through the water retort required to be nearly equal in weight to the coal to be carbonized in the other. Accordingly, for each ton of coal used, it would be necessary to evaporate about a ton of water, and to consume about a quarter of a ton of charcoal, or rather of coke, to produce the requisite quantity of water gas. These would, to a certain extent, show the additional quantity of fuel necessary in the hydrocarbon process. Fortunately, however, there is no necessity for having recourse to calculations founded on these data, and to which, no doubt, objections would be raised. We have statements given of the expense of manufacturing water gas; and, though there is a wide difference between them, I shall take those given by Mr. Clegg in his report, not because I consider them correct, for I think he states the expenditure by far too low, but because they are given by one who advocates strongly the hydrocarbon process, and whose report has been extensively circulated by those who have an interest in it. Surely they will not find fault with me for adopting these statements.

In Mr. Clegg's report it is stated that 1000 feet of Boghead coal cost in the manufacture, including coals at 28s. per ton, labor, lime, fuel, repairs on retorts, &c., 2s. 11½d.—that is, 35d·5. According to Mr. Clegg, water gas, manufactured by the passage of steam over coke, cost 5d. per 1000 feet; and 1000 feet of hydrocarbon gas from Boghead coal, at 28s. per ton, will cost, including the same items, 1s. 0¾d.—that is, 12d·75; 13,500 feet being got from the ton of Boghead when carbonized alone; 52,000 feet from the ton by the water process. The comparative expense, then, of the manufacture of gas per 1000 feet, is as 35·5 to 12·75, or very nearly 3 to 1, when the quantity of hydrocarbon gas stated is got from the ton of coal. Of course, the price per 1000 feet will vary according to the quantity obtained, 5d. per 1000 feet being taken as the price of the pure water gas itself. Were the gases of equal illuminating power, then there would be a very great saving; but, in ascertaining the value of a process of this kind, the value of the gas, not only bulk for bulk, but of the total quantity per ton of coal, must likewise be taken into account. The results of my trials show that each foot of the Boghead gas gives the light of 11·79 candles, consuming 120 grains per hour, while a foot of the Boghead and water gas gives that of only 4·73 candles; consequently, to get the same light from both, for every 1000 feet of the Boghead gas used, we must consume 2490 feet of the hydrocarbon gas, and must pay accordingly for it. The consumer ought to be aware of that, and, consequently, he ought to get his hydrocarbon gas, per 1000 feet, for less than half the price that he pays for the Boghead; otherwise he is a loser by using it instead of the Boghead, or another gas of the same illuminating power as the Boghead. But, again; the important question here occurs, can the manufacturer afford to dispose of his hydrocarbon gas at this lower rate? If the statements that have from time to time been published regarding the hydrocarbon gas be correct, then he ought to do so; but, on further investigation, I fear we must come to a very different conclusion.

Assuming the accuracy of the results of my trials with Boghead, and with Boghead and water together, let us see how the matter stands; and

what I have now to say, applies not only to my own experiments, but likewise to those of Dr. Frankland and Mr. Clegg. The average result of my six trials on the Boghead coal yielded 16,093 feet of gas per ton. Take the coal at 28s. per ton, then

| | | | |
|---|---|---|---|
| Cost of Coal, - - | 28s., or 336d., | or 20d·87 per | 1000 ft. |
| Manufacture according to Clegg, | 143d·775, | or 8d·934 | ditto. |
| Total charge per ton, | 479d·775, | or 29d·804 | ditto. |

This gas gave the light of 11·79 candles per foot—that is, 3253·5 lb. sperm per ton; 1000 feet, therefore, equal to 11·790 candles, cost 29d·8.

The average of my eight trials with Boghead and water gave 39,533 feet per ton of coal; then, as before,

| | | | |
|---|---|---|---|
| Coal and manufacture, | 16,093 feet, | | 479d·775 |
| Water gas, according to Clegg, | 23,460 " | at 5d. | 177d·3 |
| Total coal and water gas, cost | | | 597d·075, or 15d·09 per 1000 feet. |

The gas gave the light of 4·73 candles per foot—that is, 3213·5 lb. sperm per ton; 1000 feet, therefore, equal to 4·730 candles, cost 15d·09. Then,

| lb. sperm per ton, Boghead. | | lb, sperm per ton Boghead and water. | | Cost of coal gas per ton. | | Comp. cost of coal gas. | |
|---|---|---|---|---|---|---|---|
| 3253·5 | : | 3213·5 | :: | 479·77 | : | 473·87; | and 597· : 473·87 :: 100 : 79·3. |

Saving in favor of Boghead gas alone = 20·7 per cent. Again,

3213·5 : 3253·5 :: 597 :: 604·4; and 604·4 : 479·77 :: 100 : 79·3.

Saving in favor of Boghead gas alone = 20·7 per cent.

The same results are got by another process. The Boghead gas for 11·790 candles cost 29d·8. The Boghead and water gas for 47·300 cost 15d·09.

| Candles per 1000 feet coal gas. | | Candles per 1000 feet coal and water gas. | | Cost of coal gas. | | Comp. value of coal and water gas per 1000. feet. | |
|---|---|---|---|---|---|---|---|
| 11·790 | : | 4730 | :: | 29·8 | : | 11·95; | and 15·09 : 11·95 :: 100 : 79·1. |

Saving in favor of Boghead gas alone = 20·9 per cent.

| Candles of water gas. | | Candles of coal gas. | | Cost of coal gas. | | Comp. value of coal gas. | |
|---|---|---|---|---|---|---|---|
| 4730 | : | 11·790 | :: | 1509 | : | 37·6; | and 29·8 : 37·6 :: 100 :: 79·2. |

Saving in favor of Boghead gas alone = 20·8 per cent.

In these calculations the results do not exactly correspond, because I have not thought it necessary to extend the fractions. They are sufficient to show, that according to the results of my trials, in which the quantity of hydrocarbon gas per ton of coal was 39,553 feet of 4·73 candle gas per foot, there is an actual loss by the use of water in the hydrocarbon process to the extent of about 20 per cent.; and this loss is incurred in the manufacture of the gas, independent of other items.

I have next to advert to those instances in which the quantity of hydrocarbon gas per ton of Boghead was greater. When 52,042 feet of gas were obtained, the illuminating power per foot was on an average only

1·99 candles—that is, 238·56 grains of sperm per foot, and 1773·6 lbs. per ton of coal. Then, as before:

| | | | |
|---|---|---|---|
| 1 ton coal, yielding | 16,093 ft. | total cost | 479d·775 |
| Water gas, . | 35,950 ft. | do. | 179d.752, or 5d. per 1000 feet. |
| | 52,042 | do. | 659d·527, or 12d·672 per 1000 feet. |

One foot of gas was equal to 1·99 candles—that is, 1773·6 lbs. of sperm per ton of coal. Total cost, 659d·527.

One foot of Boghead coal gas, as before, equal light of 11·79 candles—that is, 3253·5 lbs. sperm per ton. Cost, 479d·77. Then

| Coal gas = lb. sperm per ton. | Coal and water gas = lb. sperm per ton. | Cost of coal gas. | Comp. value of coal and water gas. |
|---|---|---|---|
| 3253·5 : | 1773·6 :: | 479·77 : | 261·5; and 659 : 261·5 :: 100 : 39.6. |

Saving in favor of Boghead gas only=60·4 per cent.

| Coal and water gas =lb. sperm per ton. | Coal gas =lb. sperm per ton. | Cost of coal and water gas. | Comp. value of coal gas. |
|---|---|---|---|
| 1773·6 : | 3253·5 :: | 659·5 : | 1209·7; and 1209·7 : 479·77 :: 100 : 39·7. |

Saving in favor of Boghead gas only=60·3 per cent. Again,

| Candles per ft. coal gas. | Candles per ft. water and coal gas. | Cost of 1000 ft. coal gas. | Comp. value of 1000 ft. coal and water gas. |
|---|---|---|---|
| 11·79 | 1·99 | 29·8 | 5·03 ; and 12·672 : 5·03 :: 100 :: 39·69. |

Saving in favor of Boghead gas only=60·3 per cent.

| Coal and water gas. | Coal gas. | Coal and water gas. | Coal gas. |
|---|---|---|---|
| 1·99 : | 11·79 :: | 12·672 : | 75·077; and 75·077 : 298 :: 100 : 39·7. |

Saving in favor of Boghead gas only=60·3 per cent.

By this mode of operating, the above results show that the coal gas is the cheaper light by upwards of 60 per cent.

That the hydrocarbon process is not economical, is also shown by comparing the lowest results I obtained by Boghead coal alone, with the highest results by the Boghead with water. The two lowest results by Boghead alone yielded, on an average, 2969 lbs., and the two highest by Boghead and water, 3619 lbs. of sperm per ton. Taking the price the same as before, then

2969 : 3619 :: 479·77 : 584·8, and 584·8 : 597 :: 100 : 102:

there is, therefore, an increased expenditure of 2 on the 100 against the water process.

Taking the *lowest* of my results by the Boghead against the *highest* by the Boghead and water, the former is as 2856 lbs. to 3649 lbs. of sperm by the latter. Take the expense for each, the same as before, then,

2856 : 3649 :: 479·77 : 612·98; and 612·98 : 597 :: 100 : 97·3.

Hence, under the most favorable circumstances for the hydrocarbon gas, the same amount of light can be obtained by the usual process from Boghead alone for very nearly the same expense; the difference being only 2·7 per cent. in favor of the hydrocarbon process.

I have next to advert to the trials of Dr. Frankland and Mr. Clegg.

Dr. Frankland obtained from Boghead coal alone 13,240 feet of gas, 1 foot of which was equal to 10·52 candles—that is, 2387·7 lbs. of sperm per ton of coal. From Boghead and water, he got 51,720 feet of 4-candle gas—that is, 3546·5 lbs. of sperm per ton. Taking Mr. Clegg's estimate of the cost of Boghead gas at 35d·5 per 1000 feet when the coal is at 28s. per ton, then the cost of manufacture of 13,240 feet is 470d., which gas yields the light of 2387·7 lbs. of sperm; the cost of hydrocarbon gas from the same coal at the same price, according to Mr. Clegg, is 12d·75 per 1000 feet, and, therefore, 51,720 will cost 659d., which is equal to 3546·5 lbs. of sperm: then—

3546·5 : 659 :: 2387 : 443; and 470 : 443 :: 100 : 94·2.

Therefore, to get the same amount of light, there is a saving on the cost price of the gas of 5·8 per cent. in favor of the hydrocarbon process, according to Mr. Clegg's calculation of the expense. Allowing the accuracy of this statement, it will naturally be asked how it is to be reconciled with that given by Mr. Clegg. In his report, Dr. Frankland alludes merely to the *increase in the quantity of gas* by the hydrocarbon process, and to the consequent *increase in the light* afforded by the combustion of this gas, without reference to expense. Mr. Clegg has, in addition to this, referred to the expenditure of manufacture, and consequent economy of the process. But in this last part of the statement he has made a very important omission. According to him, Boghead coal yields 13,500 feet of gas per ton, while the same quantity of coal affords, by the hydrocarbon process, 52,000 feet of 4-candle gas per foot, the candles burning 120 grains per hour; and he then assumes the saving to be to the enormous extent of 285 per cent. Were this really the case, it ought at once to insure the universal introduction of the hydrocarbon process. In this statement, however, the increase in the *quantity of gas* only is referred to, for—

73,500 : 52,000 :: 100 : 385.

But Mr. Clegg has not taken the *quality* of the gas into account. Had he done so, he should have stated the result very differently.

In his Report, it is said that the data on which his calculations are based are got from practical experiments made, first by Dr. Frankland, and afterwards by himself, with a view to test the accuracy of Dr. Frankland's Report. Though Mr. Clegg has not given the illuminating power of the Boghead coal gas to which he refers; but as he alludes to Dr. Frankland's experiments, which he is endeavoring to verify, we may take the illuminating power given by Dr. Frankland—that is, 10·52 candles per foot.

Taking this, we shall see the result in a very different light. 13,500 feet of Boghead coal gas cost, according to Mr. Clegg, 470d., and yield the light, according to Frankland, of 2431·7 lbs. of sperm; 52,000 feet of Boghead hydrocarbon gas, according to Mr. Clegg, cost 663d., and gave the light of 3565·7 lbs. of sperm; then

3565·7 : 663 :: 2431·7 : 446.

But the Boghead coal gas for this light costs only 470d.; and

470 : 446 :: 100 : 94·8.

Accordingly, to get the same light, the saving in the manufacture is, by Mr. Clegg's own statement, only 5·2 per cent.

Again; Mr. Clegg has stated that Boghead coal per ton will yield, by the water process, not less than 75,000 feet of 2·4-candle gas per foot, and that there is thus *an increase of* 460 *per cent.* This statement, taken in conjunction with others in the Report, is apt to lead to the impression that there is thus a gain by the hydrocarbon process to an enormous extent; we shall find, however, on further investigation that, taking Boghead coal as before, at 28s. per ton, the cost of 1000 feet of the hydrocarbon gas, when 75,000 feet per ton of coal are obtained, is, according to Mr. Clegg, 10d.; thus making the total quantity per ton amount to 787d·5. The gas per foot being equal to 2·4 candles, the light per ton of coal will be 3085 lbs. of sperm. Here, notwithstanding what Mr. Clegg has stated regarding the hydrocarbon process in another part of the Report, that there is an "increase in volume without diminution of light," we find that there is an actual loss on the previous process. 52,000 feet of 4-candle gas are equal to 3565·7 lbs. of sperm; but 75,000 of 2·4 candle gas are equal to only 3085 lbs.; there is, therefore, a loss of 14 per cent. on the total amount of light.

With regard to the cost, the gas from Boghead coal cost, as before, 470d., and is equal to 2387·7 lbs. sperm. Then

$$3085 : 787·5 :: 2387·7 : 609.$$

But the light of 2387·7 lbs., by the Boghead alone, cost only 47d.; and

$$470 : 609 :: 100 : 129·5.$$

Accordingly, to get the same light by the hydrocarbon process that we can get by the Boghead alone, there is, by Mr. Clegg's own showing, an increased expenditure of 29·5 on the 100.

In my trials, when 75,253 feet of gas were got from the hydrocarbon process from the ton of coal, the light per foot was only that of 0·27 of candle—that is, 32·4 grains of sperm per foot, or 348·3 lbs. of sperm per ton of coal, at the cost, as before, of; then

$$\overset{\text{Cost.}}{348·3 : 787·5} :: \overset{\text{Cost.}}{3253·5 : 7356}; \text{ and } 479·77 : 7356 :: 100 : 1116.$$

Here the increased expenditure for the same light is 11·16 times the cost of coal gas alone, showing still further the loss incurred by the water process.

In the trial in which the quantity of hydrocarbon gas per ton was smaller than those above given, a loss is also occasioned. When the gas was 24,932 feet per ton, the illuminating power per foot was 6·52 candles—that is, 78·24 grains of sperm, or 2786·6 lbs. per ton of coal.

| | Per ton. | |
|---|---|---|
| Cost of Boghead gas, as before, | 16,093 | 479d·77 |
| Water gas, | 8,839 | 44d·19 |
| Total cost, | 24,932 | 523d·96, or 32d·5 per 1000 feet. |

Then, $2786·6 : 523·96 :: 3253·5 : 612·1$; and $479·77 : 612·1 :: 100 : 125.$

The extra expenditure is in this case 25 per cent. for the same amount of light that I get from Boghead alone.

All of these statements still further prove that the hydrocarbon pro-

cess not only is not economical, but, when carried to a great extent, is an expensive one; and it must be kept in remembrance that the above calculations refer solely to the cost of manufacture. There is no allusion to the enlarged gasholders, pipes, &c., necessary for the increased amount of gas that must be supplied to obtain the same light that is got from Boghead gas, and all of which must add materially to the expense.

I have said that there is a wide difference between the statements of Mr. Clegg and others regarding the expense of manufacturing water gas. Mr. Clegg says that it can be made at the cost of 5d. per 1000, which includes expense of materials, labor, tear and wear, &c. In the June number of the *Journal of Gas Lighting*, reference is made to the experiments of Magnier and others, from which it is inferred that the expense will come to 12d. From data given to me by a gas engineer of this place, it would seem to be not less than 10d. If these statements are correct—and I believe that the last-mentioned is below the mark—then the expense of the manufacture of gas by the hydrocarbon process must be far greater than what Mr. Clegg has given it, and, consequently, the loss by the use of water must be still greater than I have stated it to be.

It must, also, be kept in recollection that the expense of manufacturing gas must vary in different places, not only because the cost of materials differs, but likewise because the expense of labor, outlay on tear and wear, according to the extent of the works, is different. In taking the expenditure as given by Mr. Clegg, I have, I think, taken it at a low estimate.

The preceding remarks regarding the hydrocarbon process refer alone to its application to the Boghead coal. I have already said that I preferred that coal to others, because from the large per centage of matter condensable by chlorine which its gas contains, I considered it by far the most likely to be affected beneficially. It was my intention to extend my trials to other coals, had I obtained anything like a saving with the Boghead coal. The results of the trials I have now recorded, render it, in my opinion, quite unnecessary to take up time in trying the process with other coals. I trust that what has been written will be sufficient to prove that there is no economy in the hydrocarbon process, and that, when all things connected with the manufacture and quality of the gas are taken into account, it is a process which ought to be at once abandoned.—*Journal of Gas Lighting.*

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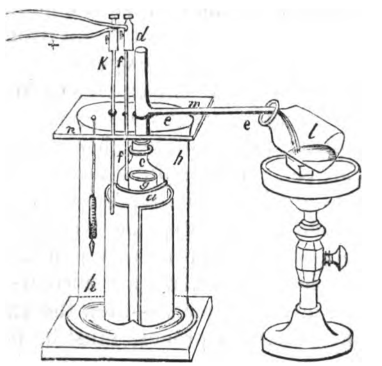
Translated for the Journal of the Franklin Institute.

## *On the Flow of Liquids from the Positive to the Negative Pole of a Closed Galvanic Battery.* By M. Wiedemann.

Independent of the magnetic, physiological, heating, and chemical actions, the galvanic current possesses besides, a peculiar force by which it transports materials from the positive to the negative pole. In reference to this, the author undertook a series of experiments, endeavoring to reduce the phenomena to some simple fundamental principle. Of

several different arrangements the following apparatus appears to be the simplest and most suitable:—



Upon a porous earthen cylinder, *a*, closed below, a small tubulated bell glass, *c*, was cemented, into the tubulure of which was introduced a perpendicular tube, *d*, with a lateral discharging tube, *e*. In the earthen cylinder is placed another cylinder of copper or platinum, *g*, with which a wire, *f*, leading to the negative pole of a galvanic battery, is connected. This wire passes through a glass tube carefully cemented to the upper part of the bell. In addition, the earthen cylinder is surrounded by a second cylinder of sheet iron, communicating with the positive pole. The whole apparatus is enclosed in a large glass jar, *h*, which, together with the earthen cylinder of the apparatus, is filled with water or some other liquid. The intensity of the current was measured by a galvanometer. As soon as the current is closed, the liquid rises in the earthen cylinder, and flows out by the discharging tube into a graduated vessel, *i*, placed below it.

By noting the quantity of liquid discharged, and using currents of different forces, the conclusion is, that *the quantities of liquid discharged in a given time are directly proportional to the intensities of the currents.*

When the conducting surface of the earthen cylinder was diminished gradually, by varnishing it, all the other circumstances remaining the same, *the quantity of liquid discharged was independent of the size of the surface.*

In the same time that a current of given intensity caused the discharge of three cubic centimetres of water from the earthen cylinder, the same current developed in the voltameter placed in its current about one cubic centimetre of explosive gas.

Although these laws already explain the general principle of the transporting action of the current, and although it necessarily follows that this action is independent of the particular causes of capillarity and endosmose, nevertheless, all the phenomena which show themselves when a liquid flows through narrow orifices, exercise a peculiar influence on the results above given.

M. Wiedemann consequently sought to find a method of measurement, independent of these phenomena, by annulling the action of their force by a simple hydraulic counter-pressure. The tube placed upon the earthen cylinder of the apparatus was closed on top, and the discharge tube, *e*, was placed in communication with a mercurial gauge. Using different currents and different amounts of cylinder surface, the mercury in the gauge rose to different heights. It results from the measurements, that *the heights to which the liquids under the influence of a galvanic current rise, are directly proportional to the intensity of the current, and inversely as the free surface of the cylinder.*

According to the results of the experiments, the pressures are to the intensities of the currents, in the same ratio as the quantity of liquid discharged by this current in the same time—a result which accords with the laws of the flow of liquid through narrow orifices.—(*Hagen, Poiseuille.*)

By means of the laws above announced, we may establish the transporting action of the galvanic current on the simplest fundamental principles.

Let there be on the two sides of a given section of a certain liquid, two plates immersed at a certain distance from each other, and presenting an electric tension in reference to each other. This section produces in the liquid a current which, if all the circumstances remain the same, is proportional to the tension itself, and to the section of the liquid. Moreover, this current draws the liquid from the positive to the negative pole, with a force equivalent to a hydrostatic pressure directly proportional to the intensity of the current, and inversely as the section of the liquid. It follows directly from the combination of these two conditions, that the force with which the tension subsisting on the two sides of a transverse section of a given liquid, transports that liquid from the positive to the negative side, corresponds to a hydrostatic pressure directly proportional to that tension.

By means of this theorem, we have a simple measure of the electric tension, and of its mechanical action, in terms of the atmospheric pressure and also of the unit of weight. The laws heretofore expressed apply only to liquids of the same nature. When the liquids are different, there is presented, at least in the mechanical action of the current, a difference which is important, and so much greater, because with equal intensities of current, liquids of great resistance transport in the same time a greater quantity of galvanic current than liquids of feeble resistance. Unfortunately, it has not been yet possible to determine the relation which exists between the mechanical action of the galvanic current and the resistance of the liquids which it traverses, on account of the imperfection of the means of appreciating and measuring these resistances. We must, therefore, as yet consider it as an isolated observation, that among the solutions of sulphate of copper of different degrees of concentration, the resistances of which have been recently determined by Mr. Becker, *there passes in the same time through the same earthen well, currents whose quantities are nearly proportional to the squares of the resistances.*

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For the Journal of the Franklin Institute.

## *On the Manufacture of Sugar.*

For a few years back, hardly a month has passed that has not brought forth some new process by which we were to obtain a great result at a very small expenditure, and the following article, taken from the London *Morning Chronicle*, will show on several points how much ignorance prevails among those who intend to revolutionize the manufacture of sugar, and to destroy the *molasses* business forever.

"*New Mode of Manufacturing Sugar.*—The new processes are fourfold

in their character, comprising, first, a new mode of obtaining the saccharine juice from the cane; secondly, a new mode of defecating and filtering the juice so obtained; thirdly, the boiling and concentrating of the juice; and fourthly, the crystalization and final curing of the sugar. The varied processes are to be seen at a model sugar house, at the works of Mr. Bessemer, Baxter house, Old St. Pancras Road, London. By the first improvement, in the construction of the cane press, a difference in the yield of the cane is obtained, as compared with the old rolling mill, of about 20 per cent. In the new machine, the pressing tubes are reduced in length from 30 inches to 12, the first four of which are parallel, and three inches wide—the next four inches of their length being taper, and terminating with a width of but 1½ inch, the smaller contracted point extending as far as the exit end of the tube. By this change of form, the entire removal of the elasticity in the "magas" occupying the tubes is removed, and after the cane has been collapsed by the severe pressure, and its breadth at the same time gradually lessened, every fibre and cell is made to assume new relative positions; not one remains unruptured, and an increased quantity of the juice is consequently expelled at the trough. In addition to this advantage, there is obviously a more equal distribution of power in each revolution of the machine; the deleterious chlorophyl, or coloring matter, of the outer portion of the cane, is not expelled with the juice, as in the ordinary apparatus; the machine may be more easily fed, and weighs considerably less than rolling machines generally in use.

"The juice, when expelled from cane, is unavoidably mixed with numberless minute fragments of cellular tissue, albumen, and other extraneous matters, which, if not speedily removed, tend to produce the acidification of the liquid. At this stage comes in the second of the processes invented by Mr. Bessemer. The present mode of defecation and filtration consists in raising the temperature of the liquor to 150° Fah., when a quantity of lime is thrown in for the purpose of neutralizing the free acid, and assisting in the coagulation of the albumen; the temperature is increased to 180° Fah., when, after allowing time for settling, the scum is removed, and the clear liquor drawn off into the "grand" copper, where it is subjected to boiling heat, when the feculent and other albuminous matters are kept constantly removed from its surface. The more completely these impurities are removed, the greater will be the brightness and value of the finished product. In the new process the juice passes through a wire strainer direct from the spout of the mill into the clarifiers, where it is raised to boiling heat by the application of steam, at which temperature it is kept for about three minutes, by which time the whole of its albuminous constituents and feculent matters will have been coagulated and chemically separated, but will, of course, still remain mechanically mixed, and, in the form of light flock, pervade the entire bulk of the fluid. These substances are then effectually removed, by a process similar to that employed in the manufacture of paper. A drum of about two feet in diameter, and from four to five feet in length, is made to revolve slowly in a small semi-circular tray or vessel. This drum is covered with fine wire cloth, through which the water forces its way, leaving a muddy coating of extraneous matters on the outer side,

which coming in contact as it revolves with a fixed scraper, similar in principle to the "doctor" employed in calico printing, is made to fall off in a state something like dry mud into a receptacle prepared for it. The process is self-acting. It takes in its own supply of foul liquor from an elevated cistern, delivers the clear juice into the evaporating pan, and discharges the refuse as we have already stated.

"Up to this stage the advantages obtained must be evident to all who are acquainted with this interesting branch of manufacture. The liquor being received direct from the press, avoids the necessity of the use of liquor pumps; the clarifiers not being used as subsiding vessels, are not required to be so large; the loss of juice in the removal of the scum, and in the sediment, is prevented; the use of the "mont-jus" is rendered unnecessary; the coagulation of the albuminous matter is more rapidly obtained; the evaporating process may follow immediately after the pressing of the canes; and, finally, the self-cleansing filter performs its work much better than any continuous process of skimming, and renders unnecessary that watchful attendance which is now so imperatively necessary in order to obtain the required brightness and color of the sugar. The saving of manual labor by these improvements is self-evident.

"On the various modes of boiling and concentrating the juice at present in use, whether by a series of semi-globular pans, the vacuum pan, Gadsden's pan, or the apparatus of Mr. Crossley or Mr. Schroder, it is not necessary now to speak, the principle involved in one and all of them being the same—that of evaporating the fluid from the saccharine matter. The inventor of the process now under consideration, contends that, in all the existing arrangements for the separation of the water from the sugar, boiling under any form, or the use of surfaces or pipes heated by steam, must be totally excluded, if the formation of molasses is to be prevented. It is a well established fact, that a thermometer placed in a solution heated by steam or the direct action of fire, furnishes no indication of the temperature to which the liquid is exposed, as a vast amount of latent heat is absorbed by fluids in their formation into steam. To the forgetfulness of this simple fact are to be traced many of the fatal mistakes at present connected with the manufacture of sugar.

"Thus, while the temperature of the syrup during ebullition in a vacuum pan, indicates as low perhaps as 180 degrees Fahrenheit, the copper worm, against which portions of the sugar are constantly brought into contact, is equal to and often above 226 degrees Fah., the consequence of which is the destruction of the color, and an injury to the crystallizing powers of the sugar. By an arrangement which Mr. Bessemer terms a hot air evaporator, the concentration of saccharine fluids may now, however, be effected without the slightest injury to color or quality, and in an increased quantity.

"This apparatus consists of a tank of thin plate iron, of about 10 feet by 8 feet, and 2½ feet in depth, which has a false bottom, curved so as to form two parallel segments of a cylinder. Above these and coincident with them is a hollow drum, of 18 inches in diameter, mounted on an axis, and on which is formed a broad spiral blade in the shape of a screw or "creeper," the thread of which is about fifteen inches in depth, and the convolutions three-quarters of an inch apart: and between each

of the blades or threads of the screw, holes are formed spirally from one end of the drum to the other. At one end of the hollow drum, air, supplied by the blowing fan, and heated to 150 degrees by passing along a flue, is made to enter, which escapes through the holes in the drum in a radial direction, and sweeps like the hot breath of the simoom over the wet surfaces of the various revolving blades, absorbs the moisture thus exposed to its action, and passes off in an invisible vapor.

"Upwards of six thousand square feet of evaporating surface is thus obtained in the small space of 10 feet by 8 feet. The screws make about eight revolutions per minute, and as they revolve, the more concentrated portions of the fluid are washed off as they descend into the fluid, and fresh portions are being constantly brought up on the surface of the screw, to be in like manner subjected to the hot-air blast. Finally, after three or four hours, the whole of the surplus liquor is carried off; the remaining fluid is sufficiently concentrated, and assumes a thick gelatinous appearance; and the screw, made to revolve in the opposite direction, expels the solution from the tank ready for the process of crystallization. By this process the sugar is not at any time exposed to a hotter surface than 140 degrees. No boiling, consequently, takes place, no slea is formed, and not one grain of crystallizable sugar is converted into molasses. The entire cost of fuel for evaporation is saved, the waste heat of the chimney and waste steam of the engine being alone employed, and the apparatus costs less than the ordinary vapor pans; it can be worked with a small amount of wind or water power. Three hogsheads of sugar, it is stated, can be obtained where two only are now produced, whilst the quality will be superior in color and taste, and will be perfectly free from molasses.

"The separation of the crystals from the mother liquor in which they are found is effected in a most ingenious and efficient manner by the use of the air pump. The transformation from the most repulsive and unwholesome-looking black sugar into a fine white sugar is completed in one-seventh of a second by this process. The principle adopted is precisely that employed in 'gassing' lace—an operation resorted to for the purpose of removing the minute filaments of cotton adhering to the surface of the fabric. In the case of the crystals of sugar, a thin film of fluid matter is required to be removed from the surface of the crystal, and this is effected by bringing it in contact with water—a material which would as quickly dissolve the crystal itself, as the flame of the gas would destroy the delicate and fragile web of the bobbin net. How can the water be thus brought into contact with the sugar for such a short period, and in such a manner as only to remove the outer coating of molasses, and leave the crystal uninjured? The process is a very simple one. A table of nine feet in circumference is made to revolve eight times per minute, having a coating of sugar spread over it to the depth of half an inch, and which consequently moves over a space of 72 feet per minute. At one part of its revolution the table is made to pass under a pipe of two inches in diameter, from which a shower of water is falling, and as the pipe is but one-sixth of a foot in diameter, and the table passes it at the rate of 72 feet per minute, it follows that each portion which comes under the

falling water will be retained only $\frac{1}{432}$ of a minute in each revolution. This table being covered with thin brass wire gauze, has placed immediately under it a vacuum chamber, into which the falling water, carrying with it the semi-fluid coating of molasses, is drawn as the table revolves, the crystallized sugar remains on the surface pure and white, and is delivered by a scraper into the hogshead placed for its reception."

Mr. Bessemer, it appears, has a new machine, by which he presses juice from the cane, which acts by a series of compressions at a high velocity, instead of the slow process of rollers. Mr. B., without saying what per centage of the weight of the cane is obtained in juice by other modes of operation, states that *he* obtains 20 per cent. more. On the best estates in the island of Cuba, having sugar mills with great length of rolls and a velocity of 2⅓ revolutions per minute, (diameter of rolls being from 26 to 30 inches,) 70 per cent. of the weight of cane is obtained in juice; if to this you add 20 per cent. the yield will be 84 per cent., which is considerably more than the cane contains; from 70 per cent. by good management, the product falls off to 50 per cent. by bad.

We are also informed that by the *new process*, the cane juice passes directly from the mill through a wire strainer into the clarifiers. Considering that precisely this process has been in use for at least twelve years, wherever steam trains have been in operation, it is rather a bold declaration to call it new.

Mr. B.'s next improvement is the substituting currents of hot air (for the purpose of evaporation) in the place of steam; to make this necessary, he informs us that while the temperature in a vacuum pan may be as low as 180°, still the copper tubes by which it is heated will show 226°. He is probably only acquainted with the ordinary Howard pan, and is not aware that in this country and Cuba, there are many apparatuses in which the temperature of the sugar in the vacuum pan does not exceed 150°, and the temperature of the steam used is only 212°, being barely of the pressure of the atmosphere; this result is produced by having increased surface for the steam to act upon, and has been in operation several years.

After the peculiar process of evaporation adopted by Mr. B., has been in operation for three or four hours, we are told that the result is a mass of crystals of sugar, not *one grain* having been converted into molasses.

Now, although he states that not one grain has been converted into molasses, still he has given to each grain a covering which he calls mother liquor, (a new name for an old friend,) and this mother liquor he removes by putting the sugar on a circular table of wire having a partial vacuum below it, and as the sugar passes under a fine stream of water, the mother liquor is drawn through into a receptacle below. If this mother liquor and water do not form molasses, what do they form? We should like to know. The only thing new that Mr. B. has produced is, his method of extracting the cane juice, and also of evaporating by means of heated air; and I venture to say that on trial both of them will be found defective.

B.

Translated for the Journal of the Franklin Institute.

## *New Uses of the Leaf of the Pinus Sylvestris.*

Not far from Breslau, in Silesia, in a domain called *la Prairie du Humboldt*, exist two establishments, equally astonishing on account of their objects and of their connexion; one is a manufactory in which the leaves of the pines are converted into a sort of cotton or wool; the other offers to the sick, as a salubrious bath, the waters left from the making of this vegetable wool. Both were founded under the direction of the head Inspector of Forests, M. de Pannewitz, the inventor of a chemical process, by means of which, from the long and slim leaves of the pines is procured a very fine filamentous substance, which has been called *wood-wool* (*laine de bois*), because it curls, felts, and may be spun like common wool.

The *pinus sylvestris*, or wild-pine, whence this new product is procured, is already much esteemed in Germany on account of several valuable advantages which it presents; and in place of abandoning it to its natural growth, extensive plantations of it have been formed, which are true forests. When planted on light and sandy soils, which it prefers, and in which it grows with the greatest rapidity, it gives them consistence and solidity. Associated with the oak, it becomes a shelter, under the shadow of which this latter acquires a great strength of development, until in its turn it rises above its protector. When the pine has reached its fortieth year, it furnishes very profitable crops of rosin. Its wood is esteemed for buildings, &c. The employment which M. de Pannewitz has proposed to give to its leaves, will without doubt contribute to spread still more the culture of a tree already so useful, and will perhaps give it some favor in other countries, where it is scarcely known.

All the acicular leaves of the pines, the firs, and coniferous trees in general, are composed of a bundle of fibres extremely fine and tenacious, which are surrounded and held together by a resinous substance in thin pellicles. When by heat, and by the employment of certain chemical re-agents, the resinous substance is dissolved, it is easy to separate the fibres from each other, to wash them, and to free them from all foreign bodies. According to the method used, the wooly substance acquires a finer quality, or remains in a coarser state; and in the first case it is employed as wadding; in the second, as filling for mattresses. Such in a few words is the account of the discovery due to M. de Pannewitz.

In practice, the *pinus sylvestris* has been preferred to others because it has the longest leaves. There is no reason to doubt that in the countries in which other species of pines exist with equally long foliage, the same product may be as advantageously obtained. There is no danger in stripping the pine of its leaves, even in its youth. This tree has need for its growth only of the whorls of leaves which terminate each branch; all the leaves which surround the rest of the branch may be stripped off without doing any harm. The operation must take place while they are yet green, for it is only then that they can serve for the extraction of the wooly substance. The stripping of the leaves is the province of poor people, and pays them good wages. The operation can only be performed every two years. The product of each gathering is one pound of

leaves for a branch of the thickness of the finger. A beginner can gather thirty pounds per day; an experienced hand may get as much as one hundred and twenty. The profit is greater from a felled tree than one standing.

The first use which was made of this filamentous substance was to substitute it for cotton wadding in quilted coverlets. In the year 1842, the hospital of Vienna bought five hundred of these coverlets, and after using them for several years, renewed its orders. It was remarked among other things, that under the influence of the pine-wool, no kind of parasitic insect harbored in the bed, and the aromatic odor which they emitted was considered to be agreeable and beneficial. Soon afterward, the penitentiary of Vienna was provided with the same kind of coverlets. Since then they have been adopted, as have been also mattresses filled with the same wool, in the hospital *La Charitè* at Berlin, and at the hospital *La Maternitè*, and the soldiers' quarters at Breslau. An experience of five years in these establishments, has shewn that the *wood-wool* is well fitted for use in coverlets, and for wadded goods, and is very durable.

At the end of five years, a mattress of *wood-wool* had cost less than one of straw, which required the addition every year of at least two pounds of fresh straw. Furniture, in the construction of which this matter was used, was preserved from the attacks of moths. It cost three times less than hair, and the most skilful upholsterer could not distinguish an article of furniture in which it is used from a similar one stuffed with hair. We are besides assured that it may be spun and woven. The finest gives a thread resembling that of hemp, and is as strong. When spun, woven, and finished like cloth, it furnishes a product which may be employed for carpets, horse-furniture, &c.; when interwoven with a warp of linen, it may be used as bed-coverings. The products of the manufactories of *Zuckmantel* and *La Prairie du Humboldt*, gained for their present owner, *M. Weiss*, a bronze medal at the exhibition of Berlin, and a silver medal at that of Altenburg.

In the preparation of the *wood-wool*, there is produced an ethereal oil with a sweet odor. This is at first of a green color; exposed to the light, it takes an orange-yellow color; when carried into a dark place, it regains its green color; by rectification, it becomes as colorless as water. It has been shewn to differ from the essence of turpentine which is extracted from the stem of the same tree. Employed in various rheumatic and gouty affections, and applied as a balm upon wounds, it has produced salutary effects; as also in vermicular affections, and in the case of certain cutaneous tumors. When rectified, it answers as an excellent oil in the preparation of the finest lacs which form the base of varnishes, and has been burned in lamps like olive oil; it dissolves caoutchouc completely, and in a short time. The perfumers of Paris use quite a large quantity of it.

It has been found that the liquid residuum which the boiling of the pine-leaves leave, exercises a very salutary action when employed as a bath; so that a bathing establishment has been annexed to the manufactory. This liquid has a greenish color verging on brownish: according to the circumstances and the mode of preparation, it is either gelatinous and

balsamic, or acid; in this latter case prussic acid is produced. During the nine years since the establishment of the baths, their reputation and the number of its visiters have been constantly increasing.

When it is necessary to augment the efficacy of the baths, there is added an extract obtained by the distillation of the ethereal oil of which we have spoken, an extract which also contains prussic acid. The liquid residuum is also concentrated to the consistency of a liquid extract, and then enclosed in sealed vessels, to be used for baths at home.

The membranous substance which is obtained by filtration when the fibre is washed, is put in the form of bricks, and dried; it then serves as a combustible, and produces a large quantity of gas for lighting, which comes from the great quantity of resin which it contains. Henceforth, it may be used for heating and lighting the manufactory.—*Bib. Univ. de Genevi., June*, 1852, *p.* 165.

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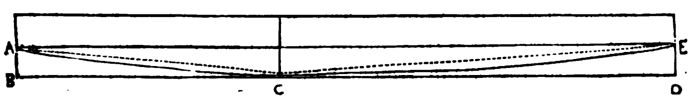
## *Hints on the Principles which should regulate the Forms of Ships and Boats; derived from original Experiments.* *By* MR. WILLIAM BLAND, *of Sittingbourne, Kent.**

Continued from page 316.

### CHAPTER XVI.

The six models just treated of were all with flat bottoms, and this for the sake of convenience. The forms calculated for service must have the curve along the bottom, as shown to be so necessary in Experiments 33 to 36. They must have, likewise, the keel deeper towards and at the stern than towards and at the stem (See Experiment 5); again, the space between the curve along the bottom and the keel must be filled up at both stem and stern; and so constructed as to offer at the bows, from the cutwater to the midship, the least resistance possible to the water; and from the midship to the stern post, to afford the easiest and most direct passage for the water, that it may act to the best advantage against the sides of the rudder.




Upon an inspection of the accompanying diagram, it will be seen that the part cut off the flat bottom by the curve A C E, equals nearly the triangles A B C, and C D E; but since a portion of the triangles will be made up by the sharp bows and body situated between the keel and the line of curvature along the bottom, it will occupy the space of about half the cubic parallelogram: therefore a quarter part only will be necessary to add to the depth at the midship section for the load-line of flotation. Upon testing the above by two models, one with a flat bottom, the other curved and yet left filled up, as required between the curve and the keel, the displacement in the water gave a quarter part as the

* From the London Civil Engineer and Architect's Journal, November, 1851.

exact difference. This proportion of a quarter part to be added to the depth at midship, applies to all the six models, from their similarity in flatness; therefore, the depth at their midship section for the load water-line should be increased by one-quarter part of their draft, when having a flat bottom at midship.

On turning back to those experiments which relate to the depths of keels, commencing with No. 44, it will be seen that the flat bottomed model (No. 2) required no keel; likewise the triangular midship model No. 3; but to the forms Nos. 1 and 4, keels were necessary.

Before deciding upon the midship section best calculated for service, it will be right to criticize those sections which have been already tested. To this end, it will be advisable to review the Experiment 41, where it appears of the triangular model No. 3, that its speed equalled Nos. 2 and 4, the latter having been previously made elliptic. In lateral resistance, No. 3 possessed the same as No. 2, Experiment 54. In stability, No. 3 proved the worst of the four (see Experiment and Table, &c., after No. 43). Lastly, in depth or draft, No. 3 again exceeds all the others. The conclusion to be drawn from the preceding facts are of such a nature as to justify the rejection of the triangular form of midship.

The semicircular form of midship (No. 1), possessed speed as one good quality; but which advantage is counterbalanced, first, by its circular outline being conducive to rolling; next, the depth at which it floats; and third, its deficiency in stability. These evils, it must be admitted, are highly objectionable, and warrant the rejection of the semicircular midship section, except where speed only is sought, when the employment of iron or lead ballast can be had recourse to as a corrective of its instability.

There remains to be considered the flat bottomed model No. 2, and the elliptic one No. 4.

The model 2, (as shown in Experiment 41,) is inferior in speed to No. 1; but as regards all other qualities, so essential to every ship, particularly for burthen, very far the superior,—1st, in floating depth (see Experiment 43); 2d, in not rolling; 3d, in lateral resistance (see Experiment 44); 4th, in stability, the means of speed (see Table, after Experiment 43).

The elliptic midship model (No. 4), as stated in the several experiments before adduced, is equal in speed to No. 2, but is slightly inferior to the same model,—1st, in depth of flotation; 2d, by rolling more; 3d, by having less lateral resistance; 4th, by possessing less stability.

The next point to be considered, before finally deciding upon the midship section, is that part of a ship's midship which is above the load water-line—meaning the sides; whether they should be continued up perpendicularly, or slightly inclined outwards, so as to present at the lee-side a larger bearing on the water, to operate in an increasing ratio against the force of the wind upon the sails.

The Experiment 63, shows that the stability of the model (No. 1) having right-angled sides, equalled the stability of the model No. 2, with its sides inclining outward; and when both were lightened, the influence of the sides which inclined outwards became apparent in the stability remaining unaltered; whereas, in No. 1, the stability was improved to the amount of half-an-ounce; consequently, there appears no

good reason for giving a preference to the beveling-out sides, over those carried up perpendicular.

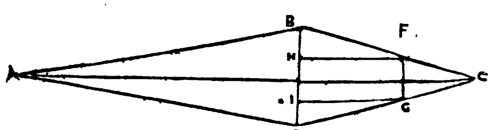
From what has been elicited, it appears that any approach to the triangular midship section has its stability improved materially by ballast, or weight; for, in fact, it is indispensable, since it possesses none without ballast.

## Chapter XVII.

The criticism of the four models of midship section being concluded, the inference to be drawn from it is, that (No. 2) the flat bottom, exceeded all the others in the essential qualities for a ship of burthen. But since speed is now become so essential a quality in a ship, those curves must be adopted which have been proved so advantageous in Experiments 33, &c., Chapter VIII.; and in consequence, the flat bottom can only be preserved entire at midships; thus making the addition of a keel absolutely necessary, both before and after that point. No. 4, the elliptic form, comes next. When carrying out the experiments undertaken, with the object of ascertaining the effects of additional weight, for the purpose of gaining an increased depth of flotation in the six models, it came out that a certain few of the models were influenced in their stabilities differently from the others.

The models in question were those which partook of, and approximated in their forms to, the parallelogram and square, and of the oval and circle; and in these the stability increased with the additional weight. On the other hand, the long fish and bird shape models ceased to improve in their stability after a certain amount of weight, they having, as it were, an early limit to any further increase of the same. This peculiar characteristic (and confined almost to the two models Q and R), is of great moment when selecting forms for various purposes; and the cause of the same must be looked for in the narrowness or sharpness of such craft, particularly towards their head and stern.

The Experiment No. 8 and Table C, exhibits No. 2, with one-fifth of the base or beam for the depth of flotation, as possessing the greatest stability. Now, admitting the depth of flotation to be one-fifth at the midship, then the depth from the midship towards both head and stern must be greater than one-fifth; indeed, be in an increasing ratio as the distance nears those extremities; consequently, the stability diminishes proportionally, as shown in the same Table C, in No. 5, being inversely to the length. Thus throwing the support of such parts upon the superior stability about the midship section; which, therefore, must necessarily be reduced. The annexed diagram will explain the meaning.




Let A B C D be the model, and B D the midship section. Take any point in the sides B C and D C, as F, and draw the line F G, parallel to B D; likewise, draw F H, and G I, parallel to A C, cutting B D in H

and I. Now, it is well known, that the straight line F G equals the straight line H I, which is part of the line B D. H I is less than B D; so also must be its equal F G.

From hence it follows, that since B D is greater than F G, then is one-fifth of B D likewise greater than one-fifth of F G; consequently the stability is proportionally less. The same can be shown of every line that may be drawn parallel to B D, between B D and the extremities A and C.

## Chapter XVIII.

Presuming thus far as correct, the difficulty then almost vanishes in relation to models or forms of ships for particular services.

To begin with boats intended for speed, and to be impelled forward by the oar. Now, it has been seen in Table No. 1, of the difference in speed between the six models when towed through the water, that the model I proved the swiftest. This model, in its proportion of length to breadth, is seven times the breadth. If greater speed be required, then eight, ten, or more times the breadth may be selected, the midship section being semicircular, and to be situated at the middle of the length (see Experiment 75), or from that to an ellipse; but the utmost care will be requisite to prevent upsetting, from its deficiency in stability.

For a steam vessel upon rivers, and without the aid of sails, seven times the beam or breadth as the length will be found to answer very well, with the midship section semicircular, and at the mid-length (see Experiment 75), or nearly so. Here iron and lead as ballast will greatly improve the stability; but then it will act as an extra load to carry.

When boats and steam-vessels are to have the assistance of sails, the length should be about five times the breadth, as the model O.

For yachts, which are vessels for speed only, and impelled forward by sail, and in consequence great stability required, then the model R, or between R and T, is the one most applicable for the purpose. The floating depth, according to Table 4, must be very shallow, yet the keel with the bottom tapered should be made to descend down into the water sufficient to obtain the requisite lateral resistance, having the lower spaces filled with iron ballast, to further improve the stability for racing purposes; the masts, &c., being made proportionally strong.

Sea fishing boats should closely resemble the model R also, because, although required for burthen rather than speed, great stability is absolutely necessary for the sake of safety, since such craft rarely have decks. Besides this, the cubic capacity of the form R is great, and at little cost, which is a consideration with fishermen. The sides also should be carried up high, both for safety and burthen.

The model Q presents the best form and requisites for the merchant service, which is made evident in Table No. 3. The proportion of its length to breadth is three and a-half the breadth. In the same Table (No. 3), it appears, that when the oblong form of model, as P, is in length five times the beam, and possessing, as is there noted, greater stability than the model O, yet the model O beat P, and with less surface

of sail, which is an advantage as requiring less weight of masts and yards.

Lastly, for ships of war, the model Q is here again pre-eminent for this purpose, particularly for the largest rates; because, in the first place, the stability increases in a degree with the load; and in the second place, of the greater bearing on the water at and towards both head and stern; and in the third, of the almost parallel sides, which afford every facility for the carrying of guns, with space to work them; but draft in the water should on no account be great, because speed is too essential a quality to be dispensed with in a man-of-war.

## Chapter XIX.—The Positions of the Centre of Gravity, of the Centre of Lateral Resistance, and the Centre of Force of the Sails.

The position of the centre of gravity in a ship, with regard to its height above the keel, should not exceed when loaded, the line of the surface of the water (see Experiment 8, Table C.); otherwise it will lose stability and become top-heavy. If situated much lower than the water-line, the stability will certainly be improved; at the same time, a greater strain than needful will ensue upon the vessel, and thus endanger the breaking of the masts and yards, if they be not of sufficient dimensions to meet it. When the axis of the centre of gravity, considered length-wise of a ship, exactly corresponds with the surface of the water, the rolling will be easy as far as the height of the said gravity is concerned; but the form of the midship section has a very great influence in checking or increasing such motion. The distance from the head and stern in a ship at which the position of the centre of gravity had best be fixed, requires no small degree of reflection, and must be decided before the laying down of the keel, because the circumstance involves both the places of the centre of lateral resistance, and the centre of force of the sails.

The sole fish has the centre of gravity in the widest part of its breadth, and which, therefore, is its centre of motion. The distance of this point from each extremity of the fish is just two-fifths of its length from the head, and three-fifths from the tail; consequently, gives one-fifth as the excess of leverage at the tail over that at the head. In a fish this is most essential, because it derives its power of locomotion chiefly from the rapid, lateral, and curved movements of the tail.

A ship, which is a body impelled forward by sails, could by no means answer if constructed altogether upon the principle of the sole fish; and chiefly on account of the centre of gravity being so forward, as stated. The consequence in practice, from the great distance apart of the centres of gravity and lateral resistance, would be a perpetual conflict against each other for the centre of motion, at the positive disparagement of the speed; for, first, the influence of gravity would place the centre of motion at two-fifths of the length from the cut-water; second, the lateral resistance would operate to carry back the centre of motion towards the centre of length; and third, the centre of the force of the sails, if not situated well a-head by means of a long bowsprit, would be perpetually causing

the ship's head to fly up into the wind. From all that has been stated, it appears in every way impolitic to have the centre of gravity situated too far forward.

In Experiments 73, &c., of the six models, it is shown that their centres of gravity taken in the solid state of the models themselves, previous to their being hollowed out—and, therefore, their true centres being likewise centres of displacement with regard to length—are situated forward and a trifle more than their mid-length. Now, if the centre of lateral resistance be influenced by the head resistance, the two centres, namely, of gravity and lateral resistance, would merely coincide. To accomplish this point, which insures the perfection, in a great measure, of easy sailing and steering vessels, it must be done through attention being given to lateral resistance at the time of making the design, as by well slanting the cut-water, without however losing a good foot-hold, and deepening the keel towards and at the stern—whose post should be perpendicular, for length of keel operates with the best effect in improving lateral resistance, whereas the deepening of it acts to overturn, and thus lessens the resistance (see Chapter XI.),—by this means, the two centres of gravity and lateral resistance will be made to approximate very closely, or quite unite. Nothing now will remain to make perfect the sailing and steering, but to place the centre of the effort of the sails perpendicularly over the two centres before-named. If this be not effected, then whichever way the preponderance of the power of the sails operates, it will, if towards the stern, cause the head to fly up into the wind; and if towards the head, cause it to fly from the wind. The helm, which is the tell-tale, will counteract in part these propensities; likewise the reduction of sail at either stern or head, but that must be at the expense of speed.

If what has been stated be admitted to be correct, the three centres then ought to coincide as nearly as practicable, when the steerage will be easy, and only require the motion of the rudder to overturn the equilibrium to alter the course.

Again, the centre of gravity, though situated correctly as to its height, may yet be extremely injurious to easy motion of pitching and scudding, if the heaviest weights be stowed very fore or aft. Instead of which, they ought to be placed at or near the position of the centre of gravity, the object being the rendering the vibration like a scale-beam, easy and without plunging. To fix the exact plan of stowage is out of the question; but it is best completed at sea, correcting any evils that may be found expedient.

The place of the centre of gravity between the head and stern, is ascertained pretty correctly by the surface of the water coinciding with the load water-line, obtained and laid down from a correct model. But the axis of its height is extremely difficult of detection; and the readiest mode which presents itself would be, the placing of three or more cups or open vessels filled with water, upon separate yet movable shelves, a few inches or more perpendicularly above each other, at the centre of the ship's width and centre of gravity, taken lengthwise. This being done, a lateral rolling motion communicated to the ship artificially, or the taking advantage of a light wind upon smooth water, and observing particularly the surfaces of the water in the cups; then if the water in

any one of them be seen merely to rise up first on one side, afterwards on the other, but in the remaining cups if the motion of the water be more rapid, even to overflowing—that first cup, wherever situated, cannot be far from the axis of lateral motion. Should any doubt on this question arise, just shift the said cup a trifle higher or lower, until the due quietude of its water surface be obtained.

(To be continued.)

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**Translated for the Journal of the Franklin Institute.**

*Account of a Diamond, larger than the Regent's, found at Nizam. Extract of a Letter, published by Capt. Fitzgerald, attached to the service of the Nizam.*

Thirteen or fourteen years ago, a very large diamond was found in the country of the Nizam. The figure which we give is that of only one part of it: a piece, which had been split off, was finally bought by an Indian broker for 70,000 rupees. The large piece, which is here figured, is now in the possession of the Nizam, and when it was discovered was shown to many Europeans.

The manner of the discovery merits to be reported. This diamond was met, for the first time, in the hands of an Indian child, who was playing with it without any one suspecting its value. Eight *annas* having been offered to the parents of the child, who were poor, the offer aroused their attention, and induced them to inform themselves as to the true value of the stone; and thus it was discovered to be a true diamond, and one of the largest known. The dimensions of the stone, measured exactly on a lead model of it, are as follows:

| | |
|---|---|
| Length, | 2·45 inches. |
| Exact breadth, | 1·35 " |
| Mean thickness, | 0·92 " |

The author of this note, having had exact glass models made from those of lead, found their absolute weight 1164·5 grains.

Specific gravity, 3·7 "

The mean specific gravity of the Diamond is 3·52 "

Supposing, therefore, the model accurate, the weight of the diamond is a little less than 1108 grains, or 277 carats for the rough diamond, and so it is generally admitted that rough stones lose one-half their weight in cutting and polishing, there would still remain 138·5 carats; that is an intermediate weight between that of the Regents' (136·75) and that of the diamond of the Grand Duke of Tuscany (139 carats;) if we suppose that the piece split off weighed one-eighth of this weight after cutting, we shall have a weight of 155·5 carets, which would place it between that of the Grand Duke of Tuscany and the large Prussian diamond, (195 carats,) which also came, as is known, from India.

It is not stated whether this stone is also of good water, which can, however, only be known after polishing; but it is known that the Indians, especially those of the Deccan, are very good judges of diamonds; and if it be true, as is reputed, that they paid 7000 rupees for the purchase, it is a favorable augury for the quality of the diamond. In the meantime,

Fig. 1.

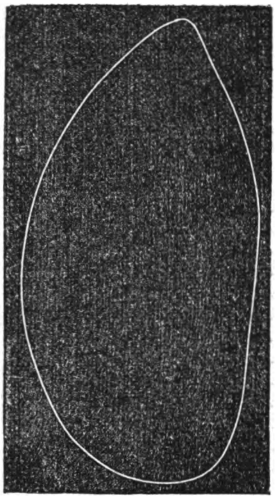
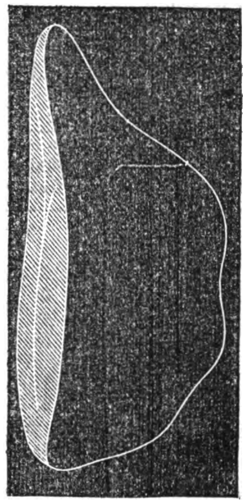


Fig. 2.



if we want an approximate value of the piece alone, which weighs 138·5 carats, as the approximate value of rough diamond is ordinarily obtained in commerce, by squaring their weight in carats and multiplying this number by 50 francs, we shall find for this one the value of 3,836,450 francs ($767,290.)—*L'Institut*, 1852, *p*. 119.

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For the Journal of the Franklin Institute.

*Dynamical Effect of Falling Bodies.—Results of Experiments made with a view to determine the dynamical effect of bodies falling freely, with the accelerated force due to gravitation.—Read before the Engineers' Institute of New York, Nov.* 18, 1852. By Chas. H. Haswell, Esq.

Existing rules regarding the momentum of falling bodies having for a long time failed to satisfy me of their accuracy, I have been led to an investigation of the subject, aided by a series of experiments, which afford very conclusive elements for the construction of the necessary formulæ to apply their results to practice.

The principal instrument used for the purpose of determining the effects was a spiral-spring weigher, which, by the attachment of spring pawls on the sides of it, delicately retained in ratchets, it was retained in its compression; and from an index, sliding over a scale graduated to half pounds, the results were enabled to be accurately registered. The weights were of lead, elongated in their shape; the cords were of hemp,

made up of loose strands, which afforded great flexibility, and the distances were determined from the centres of gravity of the weights.

By this arrangement of pawling the spring, it will readily be recognised that the weights, at their last impacts, were in no wise retarded in their full distance, and as they could not fall beyond it, the full and exact measure of their force was always obtained.

With a view to simplification and facility of comparisons, units of spaces were first decided upon, and the velocities due to them were then determined by the formula $\sqrt{s\,2g}$; *s* representing the space fallen through, and *g*, the velocity acquired at the end of the first second, *i e.*, 32·166 feet.

| Weight of falling body, in lbs. Avoirdupois. | Space fallen through, in feet. | Velocity acquired at end of fall, in feet per second. | Dynamical effect as indicated by instrument, in lbs. |
|---|---|---|---|
| ·5 | ·5 | 5·67 | 12·5 |
| ·5 | 1· | 8·02 | 17·75 |
| ·5 | 2· | 11·34 | 25· |
| ·5 | 3· | 13·89 | 31· |
| ·5 | 4· | 16·04 | 36· |
| ·5 | 5· | 17·93 | 40· |
| 1· | ·5 | 5·67 | 25· |
| 1· | 1. | 8·02 | 35·5 |
| 1. | 2. | 11·34 | 50· |
| 1·5 | ·5 | 5·67 | 37· |
| 1·5 | 1· | 8·02 | 53· |
| 2· | ·5 | 5·67 | 50· |
| 2· | 1· | 8·02 | 71·5 |

With a view to the attainment of all practicable accuracy, the entire experiments were repeated three times, and in each case the weights were made to fall until the limit of impact had been clearly obtained.

An inspection of these results shows, first, *that the dynamical effect or measure of impact, is directly as the velocity acquired;* second, *that one pound falling through a space of one foot, and having a final velocity of* 8·02 *feet per second,* has an impact of 35·5 lbs. From these elements there is readily obtained a formula by which the measure of this force, M, may be correctly arrived at, and which is,

$$M = v \; W \; 4{\cdot}426.$$

When $v$ = velocity at end of fall in feet per second, and W = weight of falling body in pounds.

Then, to obtain the weight required for a given impact and height of fall, we have by inversion,

$$\frac{M}{v \; 4{\cdot}426} = W.$$

These experiments, however, have not been made with a view to arrive at the ultimate measure of impact of a falling body; as such a result is held to be impracticable of observation, inasmuch as, theoretically it is *infinite*, and experimentally unattainable, without including an expenditure unauthorized by the benefits to be derived from them; as the law determining the effect of falling bodies is sufficiently well understood to render an illustration of this operation unnecessary. My purpose, then,

has simply been, that of giving a measure by which to estimate the effect of a pile driver or any like instrument, wherein the inelasticity and crushing of the materials composing the instrument and the pile itself, are such as to set aside ultimate attainments of impact.

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For the Journal of the Franklin Institute.

## *The Iron Steamer Richard Stockton.*

A new iron steamer, the *Richard Stockton*, has recently made her appearance on the Delaware, having been built by Messrs. Harlan & Hollingsworth, of Wilmington, Del., from the designs of Robert L. Stevens, Esq. Her dimensions are as follows:

| | |
|---|---|
| Length on deck, | 270 feet. |
| Breadth of beam, | 30 " |
| Depth of hold, | 10 " |
| Draft of water, | 4 " 2 inches. |

Her engine is of the kind known as the *top lever* or river beam form.

| | |
|---|---|
| Diameter of cylinder, | 48 " |
| Length of stroke, | 12 " |

Paddle wheels of iron exclusively, and of the kind known in England as the *Morgan wheel*, and but recently introduced into this country.

| | |
|---|---|
| Diameter of wheel, | 22 feet. |
| Cast iron paddles, | 30 inches wide, by 10 feet long. |

In this form of wheel, the paddles are attached to the arms of the wheel by journals, on which they vibrate, and by means of eccentric motion they are made to enter and leave the water vertically. Where small wheels are a matter of necessity, or where the steamer has a great variation in her draft of water, the Morgan wheels may be used to advantage; but for our rivers, the common form will be found fully as effective, while the expense of keeping the latter in order is very much in their favor. In addition to this, the Morgan wheel is at least 50 per cent. the heaviest.

The workmanship of both hull and engine is good, and does credit to the builders; while the accommodations for passengers cannot be surpassed, much taste having been exercised in fitting up the cabins and saloons.

In speed, the *Stockton* will not be a *wonder*, judging from her performance on her recent trip to Tacony. With 22 inches of steam, she made but 24 revolutions per minute; while the *Thomas Powell*, on the Baltimore route, having an engine of the same size, can make 24 revolutions of a 28 feet wheel of the common form, and it is well known that the latter is more efficient (equal revolutions and diameters considered) than the Morgan wheel. On inquiry, I found that the *Stockton* was designed to make 30 revolutions per minute, and that the deficiency of 20 per cent. in that respect was principally owing to the boilers, which, although they have sufficient generative power, yet having but a small amount of steam room, they will *foam* or *prime*. This involves the necessity of partially shutting off the engine, and hence a loss of speed.

B.

Translated for the Journal of the Franklin Institute.

## *On the Density of the Earth.* By M. Reich.

In a previous investigation, which has become quite celebrated, M. Reich gave the number 5·45 as expressing the probable mean density of the earth. The immense and memorable researches of Mr. Baily, resulted in the larger number, 5·66. The English astronomer brought to his experiments so much care and so many precautions of all kinds, that M. Reich considered himself beaten. But neither he nor Mr. Baily could explain the much too great difference which existed between the two numbers obtained. After long years of silence and meditation, M. Reich reappears on the arena. Some modifications, and a happy manipulation suggested by Mr. Forbes, have allowed him to repeat his experiments; moreover, a careful study of Mr. Baily's work, has proved to him satisfactorily that the number 5·66 is too large. Without supporting the number 5·45, which is too small, he affirms that the mean density of the earth does not exceed 5·58.—*Poggendorff's Annal. Vol. lxxxv., Arch. des Sciences, June,* 1842, *p.* 137.

Remarks.—The same conclusion as to the error in Mr. Baily's result, was pointed out by M. Saigy, in *Revue Scientifique et Industrielle, November,* 1852. He attributes it to a slight error in the value of the moment of inertia of the lever and torsion bar. He calculates the value of the mean density from Baily's experiments, as between 5·47 and 5·55, and asserts 5·5 as the most probable value. This makes the accordance of Cavendish, Reich, and Baily, very satisfactory. M. Saigy also suggests that still greater confidence would be obtained by enclosing every part of the apparatus in exhausted glass tubes, to avoid the effects of atmospheric pressure.—*See Bibl. Univ: de Genève, Vol. xliii., p.* 180.

Ed.

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## FRANKLIN INSTITUTE.

### *Proceedings of the Stated Monthly Meeting, November* 18, 1852.

Samuel V. Merrick, Esq., President.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Communications were read from the Royal Institute, The Royal Geographical Society, and the Institute of Actuaries, London; The Smithsonian Institution, Washington City, D. C., and S. W. Roberts, Esq., Philadelphia.

Donations were received from The Royal Geographical Society, and the Institute of Actuaries, London; The Smithsonian Institution, and Prof. A. D. Bache, Washington City, D. C.; The Baltimore and Ohio Railroad Company, Baltimore, Md.; and Messrs. Solomon W. Roberts, W. H. Wilson, Dr. L. Turnbull, and George M. Conarroe, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of October was read.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Exhibitions presented their Report of the recent Exhibition of American Manufactures.

On motion, the following awards of the *Gold Medal* were made, in accordance with the recommendations of the Committee on Exhibitions, in their report presented this evening.

To Day & Newell, of New York, for their Parautoptic Bank Lock.

To Henry H. Stevens, of Webster, Mass., for his manufacture of Linen Sheetings, Diapers, Crash, &c.

To W. H. Horstman & Son, of Philadelphia, Penn., for their manufacture of Fancy Taffeta Bonnet Ribbons.

To W. P. Cresson & Co. of Philadelphia, Penn., for their manufacture of Tinned Hollow Ware.

Resignations of Membership in the Institute (49) were read and accepted.

New candidates for Membership in the Institute (120) were proposed, and the candidates (12) proposed at the last meeting were duly elected.

[The scientific discussions at this meeting are unavoidably omitted.]

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## COMMITTEE ON SCIENCE AND THE ARTS.

### *Report on Mr. J. Thomson's Apparatus for Boring Artesian Wells, &c.*

**The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, an "Improvement on the Machine for Boring Artesian Wells," invented by Mr. John Thomson, of Kensington, Philadelphia, Pennsylvania,—Report:**

That said machine consists of a cylindrical iron weight, from six to eight feet in length, and from three to four inches in diameter; to the lower end of which a chisel or cutting tool is attached. An iron rod of about one inch square, and having in a portion of its length a twist given to it of from one-fourth to one-half turn per eighteen inches or two feet, is connected with the upper end of the cylindrical weight, by means of a swivel joint. The twisted portion of the rod passes through two small metal disks, one of which, having a square hole, serves as a guide to the rod. These disks are connected together by four elliptical steel springs, intended by their pressure upon the sides of the boring, to retain the guides in their proper position. Shoulders, movable at pleasure, are so placed upon the twisted portion of the rod as to prevent more than about eighteen inches of the latter passing freely through the guides; in doing which, it must necessarily make a part of a revolution, and the operation of raising the weight being comparatively slow, and the friction on the swivel joint considerable, the weight revolves with it; but when allowed

to fall, this latter drops without turning, in consequence of its inertia and of the friction upon the swivel being in a great degree removed.

It is worked in the Chinese manner, by means of a rope attached to the upper end of the rod, and may be made to strike any required number of times in a revolution, by shifting the position of the movable shoulder. This instrument is an improvement on that used in China, and which was introduced into Europe about the year 1828, for the purpose of overcoming certain difficulties attendant upon the ordinary method of boring by rods.

The most important of which are, 1st, The weight of the rods when the boring has attained any great depth. 2d, The time consumed in cleaning the hole, which must be done once for every foot or eighteen inches of depth; the operation sometimes requiring an entire day. 3d, The vibration produced by the great weight and length of the rods, causing them to break in some instances into several pieces. 4th, The bending of the rods, and consequent change of direction in the boring. From these objections the Chinese method is in a great degree exempt. But it has one peculiar to itself, namely, the irregularity in the turning of the chisel; it being necessary, in order to insure its revolution at all, that one man should be constantly employed in turning the rope, while the others work the machine; and this, as may be readily conceived, cannot be attended with altogether satisfactory results. It was to remedy this defect that Mr. Thomson's machine was devised.

The Committee were much pleased with its operation in model, but feared that in practice its revolution would be impeded by the friction against the rock, or by any slight obstruction which might take place, and thus the benefits anticipated from its use be in a great measure destroyed. To overcome this objection on the part of the Committee, Mr. Thomson caused a working machine to be made, and placed it in a well in Mr. Greble's marble yard, where it drilled a distance of thirty feet five inches through a hard gneiss rock; the greatest depth accomplished in one day being six feet and a half, from nine feet to that of fifteen feet six inches.

To test it still further, the Committee met at Mr. Greble's on Monday, 7th instant, when the machine was put up in such a manner as to permit its being examined with the greatest facility. The endeavor was made to prevent its turning, first by pressing the hands on either side of the weight, and then by means of two boards fastened together at one end, and giving a leverage of some three or four feet; but notwithstanding the friction thus produced was so great as to require the utmost exertion on the part of the men to raise it, yet so long as the body causing the friction remained stationary and allowed the weight to ascend, the latter turned with as much certainty and precision as when working freely.

The Committee are, therefore, of the opinion, that their fears above expressed, were groundless, and that the machine is a great and decided improvement on the Chinese method, and that it is superior to any other method within their knowledge. They are also of opinion, that any tendency which may exist in the Chinese instrument to depart from the ver-

tical, is obviated in that of Mr. Thomson, through the weight being always retained by the guides in the axis of the boring.

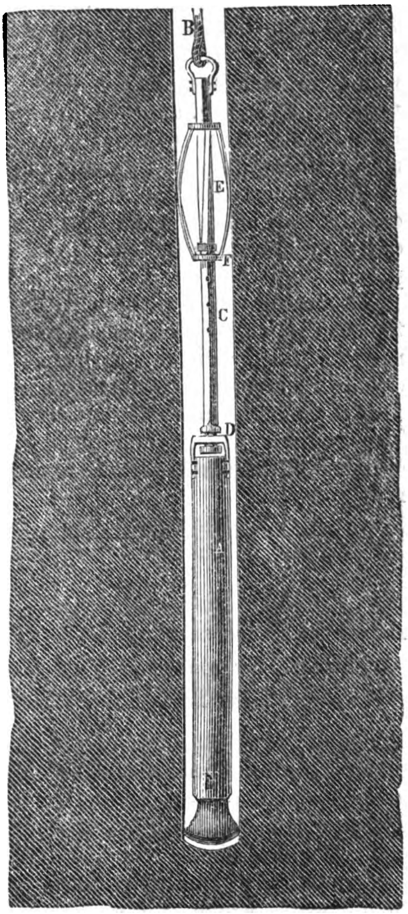
By order of the Committee,

WILLIAM HAMILTON, *Actuary*.

*Philadelphia, Sept.* 10, 1852.

DESCRIPTION.

A is a cylindrical iron bar, nearly filling the bore-hole, and about five feet long; to the bottom of this is attached the chisel for drilling. On the top of this cylinder at D, is a swivel with a square iron bar about four feet long and one inch diameter, passing through an elliptical steel spring, and fixed to the rope B. The elliptical spring, E, is of four strips, 18 or 20 inches long, and embraces the sides of the bore-hole in the rock, the lower disk of which has a round and the upper a square hole for the bar, C, to work in. It will be observed, that there is a twist of about a quarter turn upon the upper end of the bar, C, and a ring or shoulder, movable at pleasure, is fixed upon this bar, and within the spring, as represented at F. The spring, E, acts as a brace by pressing outwardly, and remains in a fixed position while the machine is at work.




Various methods may be adopted for working this apparatus, either by manual power or otherwise, as all that is necessary is to raise and drop the machine about 18 inches, more or less, by means of the rope from the surface of the ground.

The figure in the engraving represents the machine suspended in the hole in the rock, having been raised a little; its operation is as follows:

The power from the top by pulling the rope lifts the whole, except the spring, E, (the bar, C, merely passing through it;) but as C is a square bar, and the top disk of the spring has a square hole neatly fitting it, and as there is a twist upon that portion of the bar, it follows as a matter of course, that the whole apparatus, except the spring, will turn round a

portion of a circle when rising, agreeable to the twist upon said bar. Having thus raised it 18 inches, the shoulder on c, represented within the spring at F, will be nigh the top of the spring, and the next action is the drop, which must be done in the freest manner, when down comes the weight, A, exactly in the same position in which it was suspended, without in the least following the back course of the twisted bar, which in the drop merely resumed its former position. This straight drop of the heavy weight was obtained from the swivel, D; for although that swivel lifts the weight and bears it round with itself in the rising, it will be observed that there is no weight upon it whilst in the act of falling, as the bar, c, comes down by its own gravity as quick as the bar, A. In raising for the second stroke, the heavy cylinder, A, with the chisel, is swung round another portion of a circle by means of the twisted bar passing through the spring, and being suspended freely in the middle of the bore-hole, the drop is perpendicular, and in the position in which it hung. The spring is gradually carried down as the boring proceeds.

According to the nature of the rock, the chisel will make any number of strokes or cuts for each revolution, by shifting the shoulder, F, to another position upon the bar, c, which allows more or less of the twist to pass through the spring.

To clean the hole or boring, the machine is wound up by the rope to the surface, and the cleaner substituted for the chisel. Any size of hole may be drilled with this instrument, and it will work for a few feet in depth or many hundred feet by simply lengthening the rope.

It is a simple machine, and any good machinist may construct them. The common chisels and cleaner are used, but modified to suit. The cleaning of the whole is done rapidly, as there are no rods to detach, as in rod-boring.

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## BIBLIOGRAPHICAL NOTICE.

*Industrial Drawing, comprising the description and use of Drawing Instruments, the construction of Plane Figures, &c.* By D. H. Mahan, &c. &c. New York: John Wiley, 1852. 8vo. pp. 156.

The object of Prof. Mahan in this work, is to explain the method of drawing, as well from models as from diagrams, the use of instruments, &c., in such a manner as to be easily understood by a common workman, and thus to render them intelligent agents in doing things which they now do blindly, and of course badly. Every one who has had occasion to have a machine of any complexity constructed, will appreciate the advantage of such a work, which is intended as a text book for instruction, and is very full as well as very clear and explicit. A chapter on Topographical drawing is affixed. We need scarcely say, what the name of the author will assure most of our readers of, that the work is executed with great ability, and is handsomely presented before the public.

Ed.

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## LIST OF AMERICAN PATENTS, WITH REMARKS, &c.

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